MTM

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In This Issue . . .

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The Journal of Methods Time Measurement

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MTM

MTM ASSOCIATION FOR STANDARDS AND RESEARCH

The Journal of Methods-Time Measurement is dedicated to the technical aspects, application development and general news items concerning the advancement of MTM.

The Journal encompasses the fields of endeavor that were formerly publicized in the MTM Newsletter and MTM Bulletin.

The technical section of the Journal is concerned chiefly with recent research developments both from the established research program at The University of Michigan, Ann Arbor, Michigan, and from somewhat smaller allied projects being conducted throughout the Association membership.

New applications of MTM as well as refinements of established applications are presented in the Application Section to illustrate specific approaches to management problems that can be solved through the use of Methods-Time Measurement.

Current events in the lives of persons associated with MTM are described in the general news section.

The Editorial Staff welcomes contributions for all three sections described.

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Editor........................ Richard F. Stoll

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MTM FEATURES

Presented at the National MTM Conference
June 9-10, Toronto, Canada

WHEN TOP MANAGEMENT SUPPORTS MTM

by

Maynard Research Council
Harold B. Maynard, President

THE SIXTH-GRADE son of a psychologist was seated dejectedly on the front steps of his home. There was no one to play with, because all his friends were doing their homework. "And why," asked his father, "aren't you doing yours?" The boy replied: "Well, Dad, I never bring any work home. You see, I've adjusted myself to inferior grades."

There is such a thing as being too well adjusted, of becoming accustomed to accepting without mental stress or emotional strain inferior results, results at a much lower level than could be attained with a more determined effort to do better. It is a state that every top manager must steadfastly seek to avoid. As the Association of Consulting Management Engineers puts it in its report on the "Common Body of Knowledge Required by Professional Management Consultants."

> "The manager must be the steady force behind innovation. If he wants the company to progress, he must never permit himself or his people to become satisfied with things as they are, whether it be products, methods and processes, markets, or the use of the company's capital. He must always strive to stimulate his people to seek better ways of doing their assigned tasks."

It has been amply demonstrated by the experiences of the past twelve years that MTM is an extremely powerful tool of innovation. It has many uses. Of these, the most important under present conditions are undoubtedly methods improvement and work measurement undertaken for the purpose of reducing costs.

Top management has always been interested in reducing costs. Indeed, under the competitive conditions encouraged by the free enterprise system, continuing cost reductions are necessary to maintain profitable operation. But top managers are interested in many other things as well. During the last decade in particular, there have been a number of interesting new developments which have claimed their attention—long-range planning, marketing problems of all sorts, new product development, automation, electronic computers, and so on. It is not to be wondered that some managers have permitted themselves to become engrossed in these things and have not given the necessary share of their time to the active support of cost reducing activities.

This is regrettable in any normal competitive period. As Harlow Curtis, former president of General Motors, once said: "Remember that no strike, no war, no disaster can so completely and irrevocably destroy a man's business or his profits as better methods in the hands of an enlightened competitor."

But failure adequately to support methods improvement and cost reduction activities under today's world conditions is downright dangerous. It may even, indeed, be fatal. For we are in a battle for survival today which is going to require the very best that management has to give if it is to be won.

Survival is a strong word. According to the dictionary, survive means "to outlive; outlast; live through." More somberly, it means to remain alive; to exist. The instinct for survival is built deeply into every human being. It is the strongest motivator that each of us has. But it is so strong that it tends to set man against man and nation against nation. And in today's battle for survival, there are many weapons being used. Management skill may well be one of the most important.

We in the Western World have ever before us the threat to the way of life we love which is imposed by Communism. This is a two-fold threat; the threat of hot war and the threat of economic competition. For a while, it seemed that management had done a pretty good job of containing the threat of hot war. This is the kind of job that all of us in Canada and the United States have always felt that management knows how to do superbly well. It can translate the needs of a customer into products which meet those needs with unsurpassed efficiency. When the customer—which is our governments, in this case—needs jet aircraft, rockets, missiles, and the like, management, when the necessary people and resources are placed at its disposal, can produce them in any needed quantity.

So far, we have felt that the productive efforts of management have made our countries so well armed that it would be most unprofitable to attack us. But our competitor may not share this feeling. Certainly there has been a great deal of renewed sabre rattling recently, enough to show us that we cannot relax for a moment in our efforts to remain militarily strong.

But serious as this is, it is in the field of economic competition that we probably face a much more dangerous situation. The Communist nations are now seeking to undermine the Western nations economically in world markets and are striving hard to belittle our way of life in the minds of the uncommitted peoples of the world. And, unfortunately, they are making progress. Certainly we in the United States have read with uneasy concern of the amount of gold which has been leaving Fort Knox in recent months. How much of this can be attributed to present Communist economic competition, it is hard to say, but certainly this competition has had an effect, and it is something which it is very difficult to combat.

For one thing, the rules of the game are different for the two contestants. The Communist countries in general have greater control over their total situation. They can order any goods they wish to have produced and can sell them for any price they please. They can use the entire resources of their countries to capture a single market if they decide to do so. The cost may be much greater than the return received in a given situation, but backed up by the full resources of their countries, the Communists can wage economic warfare almost indefinitely if they feel that their political purposes will be served by so doing.

We, on the other hand, are organized into much smaller units. Each unit has very limited resources, even a big unit like General Motors. Any given unit must receive a return for its work which covers its costs and produces a profit if it is to stay in business. No individual company in a free private enterprise economy can meet unfair competition indefinitely. Eventually, if pressed by Communist competition, it must either withdraw from world markets or turn to our own government for subsidies. This latter course makes the game more even, but it also moves us closer to the Communist way of doing things.

The competitive battle between the Western and the Communist countries will become an increasingly bitter battle for survival as it develops, and no one can foresee the outcome at this point. But it is a battle for survival which Western management is well equipped to fight, and there are many things that we can do right now which will strengthen our position.

In any test of economic strength, the company or the industry or the nation which has the lowest cost products has an important advantage. So while not wishing to imply that cost reduction is the universal panacea or even that it is the only important area for concentrated management action, I do not believe it to be an exaggeration

to say that continuing, aggressive cost reducing, production increasing activities are essential to the future of our nations. It is, therefore, both timely and peculiarly appropriate for us at this annual meeting of the MTM Association to ask what can be done to obtain even greater results in the future than have been realized in the past from the powerful tool of cost reduction which has been entrusted to us.

This, it seems to me, is much more a management problem than a technical problem. Although the basic MTM procedure itself may be refined and further developed over the years by continuing research and although greater application skills will continue to result as time goes on, the tool of MTM, properly supported by top management, is capable of giving us much greater increases in productivity than we have been getting up to the present time. We have little cause to be satisfied with our present rate of progress. Russia is increasing its productivity at about twice the yearly rate we are. It does no good to excuse this because they are presently at a lower point on the scale than we. We still have plenty of room for greater improvement than we are making up to now.

What specifically should we do? Let's assume that we have been asked this question by a top manager who, impressed with the seriousness of the world situation as we have just described it, has decided to make his contribution to the strengthening of the Western economy by making an all out drive for reduced costs in his own plant. He has heard a good deal about MTM from various sources, and he has decided to use it as his major cost reduction tool. Now he asks our advice on how best to use it. What are we going to tell him?

I suggest first that we should tell him either directly or subtly that he must begin by understanding clearly what MTM is. One top manager I know has never been able to recognize that MTM is merely a tool of methods improvement and work measurement. He continues to this day to look upon MTM as a complete incentive system with which he would like to replace an old outmoded incentive plan, rendered unsatisfactory by loose and inconsistent standards. He wraps up job evaluation, base rate determination, incentive payment, and standards rationalization problems all in a package which he calls MTM. As a result, all discussions of the total problem are muddy and confused.

It is important for the manager to separate MTM from other management procedures and and problems with which it may be closely related and keep it separated both in his own mind and the minds of all others in his organization, both management people and workers. Otherwise, endless confusion will be the result. Some companies during and after World War II permitted their standards to become loose and inaccurate. When correction eventually became necessary, they turned to MTM as a modern, accurate tool of work measurement. This was perfectly proper so long as in the process MTM, the tool of work measurement, was not permitted to become entangled with the problems which are always involved when old loose standards are replaced with new, more accurate standards.

But this will happen only if management will take the trouble to use precise terminology in all of its discussions of the situation. A year or so ago, I passed a picket line where placards were being carried saying "Down with MTM." The company had permitted MTM to become synonymous with a standards correction program, and MTM provided a convenient symbol for protest. Ten months later in the same company, the union requested MTM studies in another department which still had old inconsistent standards. The confusions over MTM had been straightened out, and the union had come to recognize the fairness of the MTM procedure. But the confusions need not have existed in the first place had there been a clearer understanding of the role of MTM in the over-all situation.

Having learned what MTM is, the manager should learn enough about MTM to direct its use effectively. MTM can be used for many purposes, and unless the manager knows what they are, he cannot help his organization get the maximum benefits from the procedure. For example, after a brief explanation of how the procedure works, most people can readily see how it can be used effectively for measuring the time it takes to do simple highly repetitive jobs. It is not so easy to see that MTM provides the key to the practical and economic measurement of indirect, nonrepetitive work such as maintenance and receiving and shipping. Yet in many companies, the greatest potential for cost reduction lies in the measurement and control of indirect labor. It is essential that the manager should know enough about MTM to appreciate how it can be used for that purpose.

Every industrial engineer who uses MTM has undoubtedly felt at one time or another that if only his manager knew more about MTM, he would give it more enthusiastic support. Too often, however, when the opportunity arises to

discuss MTM with the manager, the industrial engineer will make the mistake of explaining how the procedure works—which naturally is a matter of intense interest to him—rather than explaining what it will do for the company—which is what the manager is interested in. The fact that the procedure eliminates performance rating, is quick and accurate to apply, reduces the time required to develop a time formula by 75%, and so on is not nearly as interesting to the manager as, for example, the fact that it will permit him to reduce his maintenance costs by 30% to 40% and get a better job of maintenance done at the same time.

When I say that the manager should learn enough about MTM to direct its use effectively, I include, of course, every key member of the management team. Nearly everyone has recognized the value of appreciation training in MTM for all of those who are going to have any contact with it during its installation and subsequent application. We should not have much difficulty in getting our hypothetical manager to agree that appreciation training for his management team is essential.

Strangely enough, however, it is not always easy to win acceptance for the fact that the people who are going to apply MTM also need training—the most thorough, highest quality training which it is possible to obtain. The MTM procedure is deceptively simple. At first glance it looks as though it can be learned very quickly. Indeed, from the time that the MTM procedure was first publicly announced, there has been constant pressure from many sources to reduce the time devoted to MTM training. Personally, I believe this is a mistake. There is a good deal more to using MTM properly than learning to recognize reaches and moves and grasps.

In addition to developing facility with the application of the procedure itself, there is much for the new man to learn about using it for improving methods, measuring nonrepetitive work, estimating, and so on. Experience has shown that time devoted to application training after the mechanics of the procedure have been mastered is time well spent. So I suggest that we should recommend to our manager that he should insist that his MTM staff be thoroughly trained, not only the staff that receives training when the procedure is first introduced, but every new man who joins the staff thereafter.

Once everyone knows what MTM is all about, including the manager, I would suggest to the manager that he should keep in sufficiently close touch with day to day application problems to be able to give any guidance and support that may be necessary. MTM is a tool of many uses. It can be used for methods improvement and work measurement on direct and indirect labor. It can be used in the factory and in the office. It can be used for estimating, for guiding product design, for tool design, and for selecting or designing effective equipment.

These uses involve many areas of the organization. If MTM is entrusted to an industrial engineering department reporting to the works manager, as is so often the case, the industrial engineering department is not in a position to do much about extending the use of MTM to the sales office, the controller's department, the engineering section, or the purchasing department. It becomes the function of higher management to recognize the potentials for cost reduction through MTM application that lie in the many different areas of the business, and to take the steps necessary to see that they are realized. The industrial engineer will be eager to extend his MTM activities to new fields, but he will usually need the support and help of top management before he can do so.

There is another form of help which top management can give. MTM is a tool of great refinement, a tool which permits studying methods motion by motion. It can distinguish differences in method as small as a single finger motion or an inch in the length of a reach or a move. This is very useful in studying methods, of course, but it sometimes leads to overcomplication when it comes to establishing standards. Because MTM can recognize differences in method which affect the standard in the fifth decimal place, industrial engineers have been known to want to establish separate standards for similar jobs if the computed standards differ by a fraction of a TMU. This, however, usually generates such a mass of paper work as to be costly and impractical. In one installation recently, the whole work measurement program was in danger of being discontinued because of excessive paper work costs caused by over refinement. Fortunately, the top manager recognized that this was not the proper solution to the difficulty. He directed that the system be simplified and made practical but did not abandon the control given by proper work measurement. He helped the industrial engineer and others to see in proper perspective the relative value of the forest as compared with the individual trees, which from his vantage point he was able to recognize better than those who were immersed in too many details.

It should go without saying that once the top manager has decided to make use of MTM, he should give it his full support. Every experienced manager recognizes that when anything new is introduced, there will be those who will object to it. Therefore, when MTM is first introduced, the top manager will usually be prepared to help support it during the initial stages of the installation.

But MTM is a dynamic tool. In everyday application, it causes constant change and improvement. New uses are constantly found for it, and its application to a continually widening range of activities is common experience. So because its application creates constant change and improvement, it also tends to create more or less constantly the inevitable reaction of resistance to change. This resistance may not be strong in a progressive, well-managed company, but it will exist, if only because the company is made up of people.

The obvious conclusion, therefore, is that the top manager cannot plan to support MTM only while its application is new, and then turn his attention to other things later on. If he wants the steady change and improvement which MTM can bring, he must be prepared to do his part in supporting it over the years. To do less is to fail to get the full benefit the procedure can bring.

And this support must be a good deal more than mere lip service. It involves planning ahead and the skillful handling of one of the most difficult problems which is generated by changes and improvements which result in higher productivity.

This point is worth pondering upon in some detail. In most cases, when we achieve higher productivity, the result is a saving in labor. When we study methods by MTM, we almost invariably discover quicker, simpler ways of doing the work. In effect, we make it possible for one man to do the work formerly performed by two, and thus we save labor. This is highly desirable from many viewpoints. It makes it possible to reduce costs, increase sales, obtain greater production from a given set of facilities, and improve profits. In the long run, experience has shown that total employment also increases.

But in the meantime, the man whose labor was saved has a very real personal problem. And when the labor of many people is saved, the community or the country at large has a social problem, a problem which constitutes a serious obstacle in the march toward higher productivity. MTM does not usually cause such sweeping, spectacular changes as the introduction of automation, but it does cause an almost steady stream of labor saving improvements. Top management must be prepared to recognize and deal with the problems which this creates if the whole forward progress of the program is not to bog down.

It is the manager's responsibility to run his company efficiently and to eliminate waste of all kinds. Mr. L. A. Petersen, president of Otis Elevator Company, expresses the general attitude of top management well when he writes:

> . . . "we recognize the importance of providing employment—but only when employment results in, or contributes to, useful production or gratification of human needs. Employment which merely wastes time is a criminal waste of human lives and human energy and is grossly inconsistent with the objectives of a legitimate business . . . ."

Most managers will agree with this viewpoint. A business is not a charitable institution. It cannot afford to give employement to people who are not needed to do useful work. So the obvious thing to do when labor is saved is to dispense with the labor that has been rendered unnecessary.

But in this process, we are dealing with people, not dollars or man-hours or some other numerical statistic by which we measure our progress. Saved people, if they cannot immediately be employed elsewhere, constitute a social problem.

A manager cannot hope to find answers for all of the problems which beset mankind. But he cannot interpret the area of his legitimate responsibility too narrowly. The social problem which he helps to create by "saved labor" is one with which he must be very much concerned and one which, in the interest of continuing to reap the benefits of MTM, he should do something about. If he doesn't, other people will have to cope with it, and their solutions are likely to be something the manager will not like.

When management washes its hands of the problem of "saved labor," government or the unions or both step in. The government's approach to the problem has been to spread the costs of relocating and retraining saved labor over all business through the provision of unemployment compensation, and by encouraging the shortening of the work week by placing penalties on more than 40 hours of work.

The approach of many of the unions has been more direct. Some but not all have tended to resist the introduction of labor saving procedures. Failing in this, they have often insisted successfully that the saved labor be employed whether needed or not as is evidenced by the widespread growth of feather-bedding practices.

Management's major counter effort so far has taken the form of "economic education" designed to show how everyone benefits when productivity increases. This has understandably little appeal to the worker whose means of livelihood is threatened right now. He is naturally more sympathetic to the union leader who offers to fight to keep him on the company payroll whether he is needed or not than to management who offers to save him from the devastating effects of Communist competition by laying him off.

This should be fairly easy to see and yet many managers have had difficulty in recognizing this viewpoint. On the 100th day of the recent steel strike, four Pittsburgh executives were playing golf. Their caddies were steelworkers idled by the strike. The conversation as they walked together along the course naturally dealt with the strike. The caddies were fed up with it and were ready to go back to work on almost any terms. One of the executives was curious. "Would you vote for Dave MacDonald if he were up for election today?" The answer was an unhesitating "yes" from all four caddies.

As long as unions show greater interest than management in the personal problems of people brought on by our industrial way of life, they will have the support of large numbers of these people. These people may not like to be taken off their jobs by a strike they had little or nothing to do with calling. They may even join the growing number of the general public who are beginning to wonder if the so-called "right to strike" is a sound doctrine in a highly integrated and interdependent society where a handful of strikers can idle thousands of others and affect adversely the entire economy.

But these people also have the same instinct for survival that everyone else has, and they will support anything or anybody that they feel will help them with their own personal survival problem. Education on the economic facts of life may be very persuasive to those whose security is not threatened, but it is not the answer to gaining acceptance for productivity increasing activities. The unions are more realistic. "We agree" they say "that increased productivity is good in the long run. But we are interested in the short run problems which it creates."

So we have management fighting the long-range battle for survival against foreign competition, Communist economic encroachment, and the more immediate competitive pressures which they face at home, and unions fighting the short-range battle to keep their people at work right now. And this is not good. It has a weakening effect on our entire economy. Strong as we are, we cannot afford too many glass strikes, steel strikes, or transportation strikes. We cannot afford featherbedding either. So what are we in management to do?

The answer is that management must take the human factor into account when preparing for a program which will result in saved labor. It is largely a matter of advanced planning, timing, and thoughtful consideration of the problems of the individuals who will ultimately be affected by the program.

Too often, attention is focused exclusively on technical problems until the last minute. Only when the work has finally been successfully measured, and a dry run application of the standards shows that only half the present force is needed to do the work, is the problem of what to do with the saved labor considered. If the decision is to make an abrupt layoff, management should not be surprised when resistance is encountered.

A far better and more successful approach is to begin planning for the day when force reductions will be necessary at the very start. Management is already sure that there will be savings or it would not be going into the MTM program. Estimates of the economic results will already have been made, as well as the length of time required to make the installation. Therefore, it is not at all difficult to plan for the handling of the "saved labor" problem in a way which will cause no difficulties.

There are many things that can be done. The people who are likely to be unneeded can be identified by name, and plans can be made for their future. If the plant is expanding, they can perhaps be retrained and transferred to other activities. They can be used to fill vacancies created by normal labor turnover. They can be helped to find employment in neighboring plants. Some of them can perhaps even be upgraded into higher-paying jobs. If these and similar things are done and the people involved understand that management is genuinely interested in helping overcome the problems generated by change, in most cases the changes can be accomplished cooperatively and smoothly. Trouble results largely when the need for adjustment is not anticipated sufficiently far in advance or is planned behind

closed doors and then is sprung suddenly on a scared and resentful group.

Not long ago, the Consolidated Edison Company staged a VIP tour of its new atomic energy power plant in New York. The papers made quite a point of the fact that although the new plant would require fewer workers than the old, the tour was sponsored jointly by the company and the union. They went on to point out that in the past whenever a laboring or unskilled job had been eliminated by mechanization, the displaced person had been retrained and usually upgraded. So the union saw no threat to its people in the new atomic plant—only opportunities.

Not every situation can be handled by exactly this same formula. But certainly it is evident that MTM work can proceed in an atmosphere of reasonably co-operative and harmonious relationships only if management applies to the human factors the same kind of careful, intelligent attention it gives to the technical and economic aspects of the situation.

Whether we like it or not, we are in a battle for survival with the Communist nations which would destroy our way of life. We cannot afford internal disruptions of the magnitude of recent strikes. And most certainly we cannot afford to stop the wheels of progress. It is management's task to get results in spite of obstacles to accomplishment.

So top management should give its full support to MTM. Indeed, it must if our analysis of the current dangers to the Western World is correct. MTM properly applied and properly supported has the potential for yielding productivity increases of 20%, 30%, 40%, and even more. On our ability to realize this potential, the future of our world may well depend.

Presented at the National MTM Conference
June 9-10, Toronto, Canada

MANAGING MANPOWER IN A CHANGING ECONOMY

by

W. A. Campbell, Vice-President and Secretary
Canadian Westinghouse Co., Ltd.

WHEN THIS subject was suggested to me, I hesitated somewhat to accept it as it had overtones of the expert, who had come to tell you how it was done. I finally accepted it because in the process of preparation, it would give me something to think about on a difficult subject with the hope that in this presentation to you, one or two of my points will give you something to consider, as well as myself.

This is your 9th Annual International MTM Conference—and, being international, I am entitled to assume many countries of the world are represented. Not to offend any, the subject of my talk is quite broad enough that, if I ever hope to reach a conclusion today, I must confine my remarks principally to both United States and Canada.

The title implies a fact—namely that we are in a changing economy. What do you think? The answer of "Yes" must be based on a look to the past of twenty-five years to fully appreciate the developments which have taken place. A simple remark helped to fix that time in my mind. It was at University—in a history class—when the professor said: "You are privileged to be living in these times." You can imagine how flat that remark fell after having been through, and still at the last of—six years of depression—a thing not quite fully understood by many here under age 35. The history professor continued: ". . . yes, indeed, because you are living in the midst of a social revolution." An economics professor at the same time put it another way, although somewhat more jocularly. . . ."Canada has increased her navy 100%—now she has two ships." The history professor's remark is clear—that of the economics professor will be, if, apart from other factors, you consider the changing impact of taxation.

What are some of the factors which are effecting changes in the economy of both Canada and United States, although not necessarily to the same extent?

(1st Factor)—The changing pattern in world trade is in my opinion near the top. Following World War II, each country has been busy mending its own fences, some have been able to help others do likewise, whether they were victor or vanquished—and now the international economic battle is beginning to

shape up around the globe. Canada, and to a lesser degree the United States, has felt competition in many lines from England; England likewise, with respect to Germany. Now we are all just starting to feel the effect of goods arriving from Japan. Japan, in our eyes a low cost labour market, is setting some operations up in Hong Kong because of another lower cost area, as well as for Commonwealth preference. Japan is also setting up in Northern Ireland. Japan is concerned over India's development in textiles—possibly enough to replace Japan in this field in 15-20 years—and so it goes.

In Canada, we have seen many textile companies fold up—and just a month ago, one of Canada's oldest rubber companies.

(2nd Factor)—I made reference earlier to the social revolution which has been taking place. This may be referred to in several ways, as higher wages, increased benefits as part of a higher standard of living, or as a redistribution of wealth. Regardless of what name you attach to it, some of the changes include the rise to power of big labour, different buying habits, increased taxation, both individual and corporate, and increases in the role of government.

On the international scene, we cannot help but be aware of movements within many countries to better their position in world matters, both materially and politically. We have seen many new countries come into being, only to mention recently Ghana, with Nigeria to do likewise this year. The changes involve not only political matters but also trade problems for their neighbours, and the many countries with which they will trade. As I think of this particular set of changing factors, I realize just to what extent changes are taking place daily.

(3rd Factor)—World War II stimulated the people, as part of a war effort, into many developments which, while for military purposes initially, were to be later harnessed for civilian use. Thus there has been a tremendous increase in research resulting in many new developments. Radar, Electronics, guided missiles, atomic power—are a few familiar names in our hall of fame. In other fields, the development of synthetic fibres has brought a host of new products—all these developments meaning to me that the engineer is closer to the research scientist than ever before—and as pure research continues, many amazing changes are not far ahead of us.

I could go on, but to me the factors just mentioned seemed sufficient to bring a few questions to my mind:

(1) Where does my company and job fit in this changing scheme of things?
(2) What part can I play as a manager?

There are no doubt other questions which come readily to mind—but, after all, you have a busy afternoon schedule—so let me list a few points which I consider are to the fore in forming an answer to the general questions just mentioned.

(1) You've heard it before, but it must be said here. You must manage manpower in such a way that, along with adequate equipment, there will be an increase in productivity. We must look to this increase if we are not to be snowed under by the upward economic march of the other industrial nations of the world—because the sad fact is that recent studies have disclosed there are few economies in the world today growing as slowly as that of Canada. The big question is: "How do we get the increase?"—and like many questions, there is probably no one single answer—although there may be a number of answers, no one of which is complete, but when all put together, a real step is made toward solving the problem. Let me be frank with you—as others—and I—see one main phase of the answers.

In the war years and immediate post war period, both United States and Canadian industry operated in a seller's market, with the greatest possible emphasis placed on production, which is not the same thing as productivity. Under these conditions, our bargaining with unions was comparatively soft and lax. We gradually give up position after position, which we now know we should have maintained. We lost a great deal, not only in terms of loose time values, featherbedding and feeble industrial discipline, but also in what has become known as management's right to manage. This erosion has gradually let develop conditions where in many areas of company operation, it is no longer possible to take those decisive actions that may be essential to the maintenance of a competitive position and

sustaining the continued growth and prosperity of the organization.

Many labour agreements contain provisions which have the effect of discouraging the investment of capital in new processes and equipment, because conditions regarding the introduction of changes are so restrictive, that the return on investment is unattractive. If this condition is permitted to exist for long, the results to the enterprise can be fatal.

We have all seen agreements with the spineless "mutual consent" clause in too many places—again one way to render management ineffective.

These are but two examples which came readily to mind—and for these and others, a sound management must have an answer if it is to manage—and that answer is a determined plan to regain the many lost rights which have disappeared at the bargaining table or other appropriate place. Let the employees know your position and whether they like it or not—they will realize the soundness of it, but don't ask them necessarily to admit it in a barefaced manner—their unions must live too. The unions will also realize your position. Keep hammering your position to the employees and the union—but do not make the big mistake of expecting everything to be cleared up in one set of negotiations. You must, however, make progress without fail—and you may be surprised at the respect for your position which follows—from your employees—and the union. You will be managing again—in a most important area—and this must be kept up every day of the year.

(2) My next point is that productivity must be increased if we are to compete successfully with the accelerated productivity of other countries, which can only be achieved if my first point is attained. Management must take every possible step to harness its resources, including its manpower, to increase productivity. You will hear the old cry from the union professionals, of speed-up, etc., in spite of the hard facts facing many, of lost business to overseas competition, which gradually means fewer jobs. While the increase in productivity is a responsibility of the industrialist and the businessman—thus we cannot rely too much on others—we must blaze our own path regardless of the many obstacles. You have no doubt heard the expression which I think applies here, that is: "Pull your own chestnuts out of the fire, don't ask us to do it for you."

For many years, we in North America felt that we had a mortgage on progress—and also possibly did not worry enough about the difference between increased production and increased productivity. Today the many advantages we had have disappeared—and we are hearing this from many speakers these days—and I am no exception. One recent expression I heard was on April 29th at the Annual Meeting of Noranda Mines Limited, when President Bradfield stated:

> "It is not surprising that Canadian manufactured goods cannot compete in world markets and that foreign goods are gaining a large place in our domestic market."

On the theme of productivity, you will not be surprised to find this short quote from the United Nations World Economic Survey 1958, at page 289:

> "In all centrally planned economies the advance in industrial production is to be achieved to a much larger extent than during the preceding period by an increase in output per man and to a smaller extent by a rise in employment."

You will see therefore that we are not alone when we talk the need for productivity increase.

This goal can be rough to attain, but it must be done—now—and those assembled here today will have a large part to play in its attainment—because now, more than ever before, research is closely followed by changes in design and then methods.

(3) I think those here have read enough books on management communications to agree with me that management includes not only the direction of the work force, but also the leading of that force, and that brings me to the only other matter I wish to mention today—that is—communications, which I regard as of increasing importance. When plants were small, the boss as they affected the employees naturally found their way down the line—and problems came up the same line easily—the organization line was as short as it could be. As it lengthened, due to the increasing size of plants, experience has shown

that information neither gets down nor up unless you work at it in an organized manner.

Where there is a lack of adequate information flowing, management's plans and motives are twisted and misunderstood—with the result that co-operation is poor, with all that can imply. I feel the employees should have adequate information about the Company at the appropriate times, its plans, yes, and its problems. All the information may not be "wonderful," but at least they can make their own decisions, and act with a much better appreciation of the problems and situations you describe to them—foreign competition from low wage areas, increase in productivity, lost business, and so on.

Adequate communications are hard to achieve and must be worked at day after day and show little results in the short run—but you are in business for the long run—that's where you get the pay-off—and although its benefits are hard to measure by a slide rule—they are definitely there. If you are to adequately manage, you must adequately communicate.

As we look ahead, I felt I should just add a few questions to leave you for consideration.

Question 1: What type of union leadership is ahead, and how can I deal with it?

Most of today's union leaders have come out of the shop—but already there are signs this need not continue to be the case. There is developing the professional—who has never been near the shop and can have quite different views on many things—get ready for him.

Question 2: Managing Manpower—What Manpower?

Population statistics show that the future workforce will be composed of a greater percentage of younger workers and older workers—with a valley in the 40 to 50 age group. This 40 to 50 age group is that from which management gets its managers. How will we deal with this situation? And there is another—more of the workers will be younger and better educated. I am sure this group will require careful handling.

Question 3: Any special thought for the short term requiring management action? Yes!

In Canada—and I think this applies to the United States—our laws have not kept up with the developments in our labour forces and as unions have developed. The responsibility of unions is in need of much discussion—as this area is indeed very fuzzy. Also with respect to union stewards, a judge has ruled that a union steward has no responsibility to the company employing him—only to the union. What status should he continue to occupy, if any, in company affairs—may be none. In any case—these matters of union responsibility, and the responsibility of union stewards and officers, should be arbitrated—so jurisprudence on this area is developed; and it must be discussed by you, to lead to an adequate solution of the problem by legislation—thus giving unions, their officers and stewards, the opportunity to shoulder a responsibility more consistent with the new powers they have acquired.

In conclusion, instead of summarizing what I have said for those who have been asleep, let me, with respect to the aspect of the changing economy, refer you to a recent quote in The Financial Post of May 14, 1960, which refers to immediate changes. In making reference at page 1 to the Senate investigation into unemployment, the following appears, and I quote:

". . .the Senate Committee must get down to the exact causes of present ills before it can tell what remedies are needed.

This will land the committee neck-deep in the touchy and hereto avoided problems of commercial policy. It will have to ask: What are we going to do about promoting manufacturing in this country? How, other than by encouraging manufacturing, can we produce enough new jobs to go around? How can we hold a wage and price level that will allow us to compete abroad?

Current unemployment, even if overstating honest-to-goodness hardship, is a clear warning that national policies in the economic sphere are lagging behind the realities of growth and change here and abroad."

Have we been having a change in our economy, and are we now? Answer—yes!

On the point of manpower management, you are not alone in expressing an interest in this particular topic—as is evidenced in a very recent

comment in Time, on one of the subjects I discussed, namely communications. I refer to the May 16th issue under the heading "Management," and I quote:

> "No matter how carefully management may say it, workers often do not understand what the boss is trying to get across to them. So reported Princeton's Opinion Research Corp. last week. Only 12% of the workers fully comprehend the average company house-organ article, said the report.
>
> Many terms that management uses mean little to the worker, but could be put in words that workers can readily understand, said Opinion Research."

One last quotation I recently read has a real bearing on the point I just mentioned and gives a good thought on the measurement of management—and I quote:

> "Labor has representatives today who have enrolled as students in the science of economics. They have recently again had it proved conclusively to them that neither strikes, lockouts, nor high pay and short hours furnish the permanent panacea for the working man's troubles. They have found that there is no permanent and cumulative improvement in the working man's conditions unless the higher pay and the shorter hours are accompanied with maximum production per man and the consequent low unit costs of manufacturer, marketing, and distribution. This seeming paradox of high wages and low unit costs is not a contradiction at all. On the contrary, it is this combination that the science of management makes possible. A most valuable unit of measurement for comparing the quality of different managements is the amount that the wages are higher, and, at the same time, the costs are lower in one organization than in another, or under one regime than under another. When this is realized, hearty and strenuous cooperation between the management and the workers will be the rule and not the exception, and he who wastes either time, effort, or material will be treated as the enemy of all."

I thought you would be particularly interested in this last quotation—it certainly seemed to set an appropriate note on which to end my remarks on manpower management—for two reasons—it was not said recently, but in 1922—and then by a person who means much to this group—Frank Gilbreth. . . .as set out in the book "Classics in Management" recently published by the American Management Association.

The members of this conference, particularly throughout the year, in their regular assignments, have the opportunity to develop and advance the art of manpower management—and many are looking forward to the continuance of your contributions—you must not fail them.

MTM NATIONAL

SUPERVISORY EDUCATION IN MTM

by

Donald L. Totten
International Register Co.

INTERNATIONAL REGISTER COMPANY

A little history about the company provides a good background to start. International Register Company has been in the timing controls business since 1891. Today, we compete in a vast market for appliance timers as well as our recent additions of pressure gauges and door chimes.

Competition in these lines is keen and we have been constantly pursuing cost reduction programs. The results of these programs have been rewarding in most aspects. Despite increasing labor and material costs we have kept our product price very competitive and quality standards high; for these reasons we share a large part of the market. The success of these cost reduction programs has been through the combined efforts of many individuals and departments.

We in the Industrial Engineering Department, have tried to keep this program progressing with the addition of new tools and the training of our shop and management people. These factors led us to the undertaking I am about to relate.

COST REDUCTION ENDEAVORS

Our first cost reduction endeavor was to initiate a monthly meeting with our foremen. We were interested here in having personnel other than engineers look at operations and contribute ideas that we might have overlooked. Mainly we were looking for method changes. Instead of getting ideas and suggestions we got complaints about difficult jobs—not a way to improve them. Actually these were gripe sessions. Why? This was the question we asked ourselves.

A little investigation revealed that some of our foremen did not understand motion patterns, standard data, work simplification, etc. Our concern was to make them aware of the cost to get the parts out and how to reduce the cost by making them aware of these industrial engineering tools.

THE INTRODUCTION OF MTM

About this time we became interested in using MTM for aiding us in methods. We also felt that with some careful planning we could introduce MTM to our foremen and obtain cost conscious foremen with some knowledge of what a better method could do for them.

I was interested in MTM and although I had no training in it, had a small share of success in using it for methods changes. This was the opening that persuaded management to learn more about MTM. Therefore, I spent several weeks obtaining a background with A. T. Kearney, for the purpose of using it for methods changes and training supervision.

Upon completion of the course, I wrestled with the problems I would encounter in presenting the material to not only the foremen, but other supervision plus quite a few skeptical industrial engineers who had never used MTM.

The first problem was convincing these industrial engineers of the merits of MTM. I had been working on setting up a standard data program on air presses doing a wide range of subassembly operations. The operations consisted of one to five piece assemblies with either manual or automatic ejection. Analysis of several jobs indicated that a standard motion pattern existed for jobs with the same number of parts.

Standard work areas were next laid out and motion patterns for each type of operation were established. The only major variable encountered was positioning. This was solved by arranging a table of the types of positioning encountered with a corresponding TMU value.

For a two piece automatic ejection a constant TMU value was obtained from the standard motion pattern and to it was added the positioning times observed.

Because I was the only industrial Engineer versed in MTM I had to make this data easy enough to understand so that an untrained observer could use it. The preceding had accomplished that. The positioning times were so explained that they could be readily distinguished and correctly applied. All that remained was adding the positioning times observed to the standard value already computed from the corresponding motion pattern. To date we have been extremely successful with this data and have trained two other industrial engineers to use it with a minimum of time.

I have spent this time on this standard data program because it solved effectively the problem of convincing other industrial engineers of the possibilities of using MTM. It might have been a back door approach, but the success of the data has not only interested our department but also the foremen whose departments it concerned.

We then turned our efforts to the following planning stages of our program:

1. Who should we include?
2. How can we obtain interest?
3. How should we organize material?

WHO SHOULD WE INCLUDE IN THE PROGRAM?

We answered this by asking ourselves who would benefit by such training? The answers were—our foremen, to help themselves with a knowledge of methods, and motion pattern training; secondly, our product designers, to help them realize the importance of loose fits and tight fits, symmetrical and nonsymmetrical loading, in order to minimize our assembly costs; third, our tool designers, so that they may understand the effect their dies and fixtures have on motion patterns. Another group we considered, was our cost estimators who benefit by being able to determine accurately labor costs before actual production.

The approach to these groups would have to be slightly different so we had to pick one group to start with. We had started with our foremen once before, so for no better reason, this is where we concentrated our efforts regarding this program.

HOW CAN WE OBTAIN INTEREST?

Taking a group of men and trying to teach them something, and then expecting 100% interest on their part is usually difficult. We tried to cope with this with an introduction we felt would arouse their interest. Here is how we plan to do it.

As the first session is started I introduce myself as the lecturer on the training medium of MTM. Without further ado the lights are turned off and a film clip of a simple punch press operation is shown in slow motion. As the clip is shown no other narration but what follows is made: Both hands R 10A, 8.7 TMU, left hand M12A, 12.9 TMU, right hand R12A limited out, both hands G3, 5.6 TMU, right hand M10C 13.5 TMU, left hand R4E limited out, right hand P2SSE 19.7 TMU right hand RL1 limited out, left hand R1C, 5.9 TMU, G4B, 9.1 TMU. Total TMU's 75.4 making the standard 1050 pcs/hour.

The lights are turned on and I will explain to an open-mouthed group that what they have heard was an MTM analysis of the punch press operation that they were viewing. Most of them probably will remember only that the rate was stated as 1050 pcs/hour, because they didn't understand the rest of the narration.

This approach should get us the interest we desire. But not without our next planning stage being properly attended to.

HOW SHOULD WE ORGANIZE THE MATERIAL?

Here I asked for the help of A. T. Kearney and the use of their appreciation course manual for establishing an outline for the course. With the use of this manual and my notes we organized the course material which we thought would be most beneficial.

Again, interest being a prime concern, proper preparation was a must. We prepared a set of charts similar to the ones in the MTM course. We planned to make notebooks, analysis forms and data cards available to all foremen present.

We then will announce the objectives of the course as:

1. To learn the language of this industrial engineering tool so that you will better understand motion patterns and be able to help develop better methods within your own departments.

2. To obtain substantial contributions to our cost reduction programs through an understanding of MTM.

The course schedule will be announced, as dictated by the material to be covered, as six weekly one hour sessions to include lectures, demonstrations, review sessions and group problems.

We plan to spend the first session defining MTM, and elaborating on its organization and history. We will enumerate the reasons for developing such a system and how research has developed and substantiated the original data. We will explain the unit of time and review the data card with definitions and examples.

We plan to spend some time on the advantages and limitations of MTM using charts similar to the ones most of you have used during your instruction.

This session will serve as a foundation for our following classes. We plan to have a question and answer period at the conclusion of the lecture followed by a brief review session.

Our second session will consist of a thirty minute discussion of reach and move. This will be followed by a review session consisting of calculations of different types of reaches and moves. We will conclude this session by demonstrating the motion pattern for a simple assembly operation. We will ask the class to record and calculate all the reaches and moves observed. Several questions regarding reaches and moves will be asked and the answers to the demonstration and the questions submitted as a weekly quiz.

The third and fourth sessions are planned similar to the second. We will discuss turn, apply pressure, grasp, position, release, disengage and the body, leg and foot motions. Each session will be followed by the same demonstration as before except we will expect the class to record and calculate all the motions discussed to date. Again, questions pertaining to each session and the answers to the demonstration are to be submitted as a quiz.

These weekly quizzes will be graded, returned and discussed at the beginning of each following session.

For our fifth class we will spend some time discussing simultaneous motions. This is an integral part of a majority of our assembly operations. We will show the effect on efficiency of simultaneous motions vs. consecutive motions. Some time will be spent explaining what motions can be made simultaneously with what other motions. Again the lecture will be followed by the demonstration of the assembly operation used before for the purpose of recording the simultaneous motions.

For our final session a complete analysis of the assembly operation on a standard MTM form will be completed along with a set of review questions covering the complete course and submitted as a part of a final exam. The results of the exam and the instructor's comments will be passed on to the interested management personnel to help evaluate the course.

A second part of the exam will be for each foreman to pick a job characteristic of his department, make an analysis and submit the results in the form of methods changes he has noted due to his training.

This would conclude the formal training of the foremen. Now another problem was eminent. Can we get the foremen to use their knowledge? Our cost reduction meetings were a good place to record the results, but we felt we needed some additional incentive to get the results.

To date we haven't come up with an answer to this, but we are presently considering an incentive award system.

With the success or failure of this program we feel we will profit by its initiation. We plan to use our experience gained here to plan better for our proposed future sessions with different groups.

As I stated when I began much of this program is in the future. We have spent a lot and will spend a lot more time planning this program. We feel that the benefits derived will reimburse us for this time we spend planning and introducing MTM to our supervisory personnel.

USE OF MTM IN BOXING OPERATIONS

by

Wayne B. Clark
Kellogg Co.

The title says "Use of MTM in Boxing Operations," I hope that no one will be disappointed to find out we are not going to an MTM, prize fight, as the title might suggest, but rather, I would like to discuss how we used MTM on a highly repetitive operation—that of packing cartons of cereal in cases.

THE KELLOGG COMPANY

Before I get into the subject matter, I would like to tell you a little bit about the Kellogg Company.

As you probably know we are the largest manufacturers of ready-to-eat cereals in the world. We have a total of 16 plants, with 11 located in foreign countries. At the Battle Creek Plant, which is the home plant, we produce 12 different cereals.

We produce on an average day, 5 to 6 million packages which are packed into 62 different case sizes. This represents a volume of 70 to 75 railroad boxcar loads per day.

As you can see from these figures, our boxing or packing operations require considerable labor to pack the various size packages into 62 different case sizes. A packing line normally consists of a bottom maker which folds and glues the bottom of the carton, a sacker which folds and inserts the inner bag into the package, a filler which fills the packages with cereal, and a top sealer which folds and seals the inner bag as well as the top of the carton. The packages are then delivered from the top sealer directly to a packing station. We were always seeking ways to improve our packing operation and to improve our productivity.

METHODS DETERMINATION

Prior to the time we started using MTM we were faced with the problem of determining a fair days work from our packing operators by means of time study with a stop watch.

This always presented a problem as we were faced with timing as many different methods as we had operators.

The variance in methods between operators appeared to be small and we felt they were only individual characteristics of various operators and that the group as a whole followed a basic method pattern.

What I want to discuss with you today is how we were able to develop a standardized method and work place with the aid of MTM.

We will also confine our discussion to only our larger or family size packages as opposed to our individual serving size packages.

Our first step was to develop a standard size case folder and work place for all family size packages. The work place was designed with emphasis on:

1. Most practical method of case packing.
2. Minimum number of motions and minimum length of reach and move elements.
3. Simple construction.

Due to the many different size packages in our packing operation, 4 basic size case folders were developed into which all of our case sizes would fit.

Once we had designed the work place, we proceeded to build a packing station which we could use for the purpose of experimenting with various methods of actually packing the cartons of cereal into the case.

PACKING STATION

Here we can see how the packages are delivered from the packing lines to the packing station, standing in an upright position, by means of a power belt. The operator secures a taped case from the supply beside her, opens the case and moves it through the case folder to fold the bottom of the case. The operator then reaches to the required number of packages on the conveyor

belt and moves the packages into the case. This is repeated until the case is packed in the prescribed manner. The operator is continually inspecting the top seals on the packages and when she finds a faulty seal she disposes of it in a provided container. The packed case is then pushed onto the case discharge belt which carries it through an automatic case sealer.

You will note that this experimental station is provided with a variable speed drive on the package belt conveyor.

This permitted experimentation with different speeds in order to determine a relationship between belt length and belt speed. We found that when we ran the belt slowly the packages backed up and became wedged together during the non-packing time. Our non-packing time is the time during which the finished case is being disposed of and a new case is folded and moved into position. This non-packing time amounts to 1/3 to 1/2 of our total cycle time. By increasing the speed of the belt, which increased the space between packages, we eliminated this problem. The space between packages is utilized as storage space during the non-packing time. Once we had established a relationship, we could compute a minimum belt speed for any given length of packing belt.

Other parts of the experimental station could be readily adjusted to fit the various package sizes.

WORK SIMPLIFICATION

You will note here some of the basic rules of work simplification which were designed into the station. The case folder has a height adjustment which permits the case to be raised within one inch of the top of the packing belt when the case is in the packing position.

The folder is tilted toward the operator to reduce need for control and eliminate some positioning motions which would otherwise be required.

The gap between the case and the conveyor belt are reduced to a minimum.

The rear guide rails bring the packages to within 1/2" of the edge of the apron and the package stop allows the packer easy access to the packages.

Up to this point MTM entered in the picture in that it forces us to realize the importance of minimizing the distance and number of body motions required.

With the use of this station we were able to analyze various methods of actually packing the cartons into the case in order to determine the best and easiest method.

We pack all of our products in cases of 12, 24, or 36 packages. We are handling groups of 6 or 9 packages which make up one row in the case. The net weight of the packages varies from 5-1/2 oz. to 18 oz. per package. When we are handling 6 of our smallest packages at a time, we are handling about 2-1/2 pounds. When handling 9 of our largest packages at a time, we are handling about 12-1/2 pounds or nearly 5 times as much weight.

When we reached this point in our MTM analysis, we were forced to take a good look at the force required to handle several packages as a unit by compressing the two outside packages with sufficient pressure to maintain control of the center packages.

PICKING UP PACKAGES

The packages are grasped as a unit.

Slide No. 4 is a pictorial representation of the forces which are exerted by the packages and the packing belt if we are to pick up 6 packages. For simplicity, I have shown the forces on the right hand only. Assume the packages are being carried down the belt to the packing station from left to the right. If we are to stop these packages in position on the belt to be packed into the case, it will require a force equal to that shown as "A." This force is due to holding the packages stationary while the belt continues to slide underneath them. This force is calculated by multiplying the coefficient of friction between the belt and the packages by the weight of the 6 packages. It is shown here as the force due to the belt and is calculated to be 2.2 pounds in this example.

The second force which I have called "B" is the force which will have to be exerted on the ends of the group of six packages. This force must be great enough to permit handling of six packages as a unit. Since we have to contact with only the two outside packages we must control the center four packages by means of compressing the unit. The force with which these packages must be compressed is equal to the weight of the packages divided by the coefficient of friction between

the packages. Here this force is calculated to be 14.1 pounds.

At this point we simply have control of the six packages and are prepared to pick them up. The force required by the right hand to pick them up is equal to the weight of 3 packages or 3.4 pounds and is shown as "C."

The resultant of these 3 forces can then be calculated and is 16.7 pounds. This 16.7 pounds represents the force required by the right hand in order to pick up six packages. A force equal to this would then have to be exerted by the left hand to maintain balance.

The gross weight of the packages is 6.8 pounds but the force required to pick them up is 16.7 pounds or nearly 2-1/2 times greater.

IMPROVED METHOD FOR PICKING UP PACKAGES

At this point in our method study we began to search for a method that would reduce the force required. We realized that if we were to do this we would have to reduce the force required to hold the center 4 packages out of the group of six. We found that by sliding the packages off the belt and guiding them as they fell into the case it would not be necessary to pick the packages up.

We then proceeded to analyze the force required if we were to use this sliding method.

Here we have the same force "A" of 2.2 pounds due to the belt pushing the packages. The force "B" which is the force required to control the center 4 packages is now equal to the weight of the 4 packages times the coefficient of friction between the packages divided by the coefficient of friction between the packages and the belt. This is calculated to be 4.5 pounds. These two forces are then required to control the packages as a unit.

The third force shown as "C" is the force required to slide the six packages toward the packer into the case. This represents the weight of three packages, times the coefficient of friction between the packages and the belt and is 1.1 pounds. The resultant of these forces is 6.8 pounds. Here again an equal force is exerted by the left hand.

Here are the results of the Improved Method. The force required to pick up the packages was 16.7 pounds. The force required to slide packages was 6.8 pounds. This is a reduction in the force of 9.9 pounds or 59%.

RESULTS FROM METHODS IMPROVEMENT

We have now talked about the standardization of the work place and the determination of the best method of packing at this work station. We can now ask what are the results of these changes.

The average distance saved per reach or move was 6 inches. This represents a total savings per packing line per day of 219,000 inches or 3 to 3-1/2 miles. The net result of this savings was that the packing rate for this size package was 69 per minute with the old station and is now 82 per minute with the new station or a gain of 20%.

ELEMENT ANALYSIS

At this point we realized that we had collected a great deal of information. The next step then was to assemble a standard data report.

Our first step was to make certain our MTM analysis at this point was correct. After we had done this we subdivided each element into the constant and variable motions. To determine distances and weight for the variable motions we selected four different package sizes. We selected the smallest, the largest, and two intermediate sizes and measured the distances involved in all four sizes. With this information we were able to plot the distances of the reach and moves and determine a relationship between the distances and either a package dimension or a case dimension.

Element No. 2, Pack 1st Row Into Case. Here we found the first motion "Reach to Packages" varied in relation to the case width into which we were packing. We define the case width in our report as the dimension of the case which is perpendicular to the package conveyor belt when the case is in the packing position. Our reach distance then was determined to be the case width plus 3 inches.

The next motion, "Contact Packages," is constant with no time value.

The third motion, "Separate Six Packages," we found to be a function of the case height. The distance of the move was equal to 1/2 the case height minus 2 inches.

The fourth motion, "Gain Control," is also a constant.

The fifth motion, "Slide Packages Into Case," is a function of the case width and is equal to the case width plus 4 inches.

The sixth motion, "Break Contact," is a constant.

We used this same approach on all elements of the job, and then set up tables showing leveled minutes corresponding to various case dimensions for each element.

STANDARD DATA TABLES

This gave us a series of tables which cover all of the various case sizes with which we were concerned. We can now determine the leveled minutes for any element by reading it directly from the table of leveled minutes. Our data was then assembled as shown, with the various elements of the job listed and a synthesis of the elements required for the various case sizes, 12, 18, 24 and 36.

I have a slide showing one of our multiple packing stations where we see two girls packing on oposite sides of the belt.

Due to the size and weight of some of our packages, it became more economical to replace manual packing with semiautomatic case packers. Here our giant size Corn Flakes are being packed into 12 size cases. The packer inspects the packages continually while she folds the end of the case and inserts it on the case packing horn. The balance of the filling and disposing of the case is automatic.

CONCLUSION

In closing I would like to say that MTM has been a great aid in arriving at the answers to many of our packing problems. With MTM and the data which we have compiled using it, we now feel we have a real firm base for making decisions.

We have used it to determine the most economical line speeds, and to determine where lines could be combined into a single or multiple packing station to fully utilize the packing capacity of the operators.

I hope I have been able to relate to you how we at Kellogg's have used MTM in our Packing operations.

G. ELEMENTAL TIME VALUES

Element Number	Description	Leveled Minutes Per Case
1.	Secure and set up case 12, 18, 24 or 36 Size Case	Table I
2.	Pack 1st row into case 12, 18, 24 or 36 Size Case	Table II
3.	Straighten 1st row 24 or 36 Size Case	Table III
4a.	Pack 2nd row into case 12 or 18 Size Case	Table IVa
4b.	Pack 2nd row into case 24 or 36 Size Case	Table IVb
5.	Pack 3rd row into case 24 or 36 Size Case	Table V
6a.	Straighten 1st row 12 or 18 Size Case	Table VI
6b.	Straighten 3rd row 24 or 36 Size Case	Table VI
7.	Pack 4th row into Case 24 or 36 Size Case	Table VII
8.	Fold top end flaps and dispose of case 12, 18, 24 or 36 Size Case	Table VIII
9.	Remove defective package from line	.0370 per occ.
10.	Remove defective package from case	.0512 per occ.

H. SYNTHESIS

Time per case 24 size =

$$\text{Elements } 1 + 2 + 4b + 5 + 7 + 8 - \frac{3}{\text{Freq. per case}} + \frac{6b}{\text{Freq. per case}} + \frac{9}{\text{Freq. per case}} + \frac{10}{\text{Freq. per case}}$$

TABLE II - PACK 1st ROW INTO CASE - 12, 18, 24 & 36 SIZE CASES

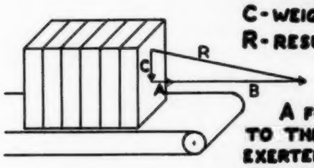
Use this table if weight of row is up to & including 7.48 pounds.

	LEVELED MINUTES PER CASE Case Height (Up to & incl.)					
12 or 18 size	8"	9"	10"	11"	12"	13"
24 or 36 size	16"	18"	20"	22"	24"	26"
Case Width (Up to & incl.) 12"	.0322	.0326	.0332	.0337	.0341	.0345
13"	.0329	.0334	.0340	.0345	.0349	.0353
14"	.0337	.0342	.0347	.0353	.0357	.0361
15"	.0346	.0350	.0356	.0361	.0365	.0369
16"	.0353	.0358	.0364	.0369	.0373	.0377
17"	.0361	.0366	.0371	.0377	.0381	.0385
18"	.0370	.0375	.0380	.0386	.0390	.0394
19"	.0378	.0383	.0388	.0394	.0398	.0401
20"	.0386	.0391	.0396	.0401	.0406	.0409

Forces On Right Hand

To Pick Up 6 Pkgs.

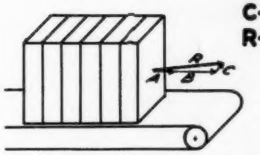
A- Force due to belt 2.2#
B- Force to hold pkgs. 14.1#
C- Weight of 3 pkgs. 3.4#
R- Resultant force 16.7#



A force equal & opposite to the resultant must be exerted by the hand to lift the packages.

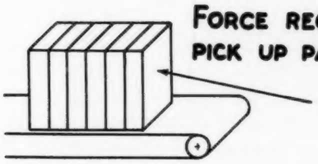
To Slide 6 Pkgs.

A-Force due to belt 2.2#
B-Force to hold pkgs. 4.5#
C-Resistance to sliding 1.1#
R-Resultant force 6.8#

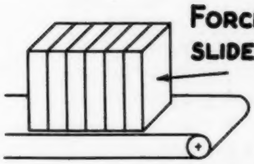


A force equal & opposite to the resultant must be exerted by the hand to slide the packages.

Results of Improved Method



Force required to pick up packages - 16.7#



Force required to slide packages - 6.8#

Reduction in force - 9.9# or 59%

Results of Improved Method & Work Place

1. Average distance saved per reach or move - 6 inches

2. Distance saved per line per day - 219,000 inches or $3\frac{1}{2}$ miles
(4,560 24 size cases per line per day, each requiring 4 reaches and 4 moves by both hands)

3. Increase in standard packing rate - 20 %
(Old station - 69 pkgs./min.
New station - 82 pkgs./min.)

Element No. 2-Pack 1st Row

Left Hand	Motion	TMU	Motion	Right Hand
To packages	R_B	VAR.	R_B	To packages
Contact pkgs.	G5	0	G5	Contact pkgs.
Separate 6 pkgs.	M_B	VAR.	M_B	Separate 6 pkgs.
Gain control	AP2	10.6	AP2	Gain control
Slide into case	M_B$_{I}$	VAR.	M_B$_{I}$	Slide into case
Break contact	RL2	0	RL2	Break contact

R_B = Case Width + 3 Inches

M_B $\frac{\text{Case Height}}{2}$ − 2 Inches

M_B$_{I}$ − Case Width + 4 Inches

DEVELOPING AND USING MTM STANDARD DATA FOR ASSEMBLY OPERATIONS

by

Richard G. Ceser
McCulloch Corporation

INTRODUCTION

Initially, I want to briefly acquaint you with the McCulloch Corporation in the event that you are among the minority present who are not familiar with our organization or products.

McCulloch Corporation has grown from a modest beginning at Los Angeles in 1946 to a world leader in the production of chain saws. We have plants in Los Angeles, Minneapolis and Toronto and are presently planning a further expansion in Europe. In addition to our light weight, power packed, two cycle, gasoline powered chain saw, we manufacture and market the Scott line of outboard motors; a four cylinder, two cycle target drone engine; a six cylinder, two cycle turbo-supercharged, high altitude target drone engine plus other related accessory products. Our total employment approximately 4,000 at the present time.

A few short years ago, the average retail selling price of our chain saws was in excess of $285.00. In the year just past, it averaged less than $225.00 or approximately 80% of the former figure. This achievement in the face of rapidly rising costs to manufacture is a real tribute to the ingenuity and determination of our Engineering, Tooling, Purchasing, Industrial Engineering and Production personnel. Also, recognition must be given to our competitors who are a constant source of inspiration.

At present, we are paving the way for the installation of a Wage Incentive Program in order ot provide additional earnings for our production personnel who are presently enjoying rates equal to or higher than the average of competitive commercial companies in the Los Angeles area. Also, this program will enable us to further reduce the cost of manufacturing our products.

This program demands that we establish work standards which are consistently fair and equitable to our employees and the company. For this reason, we are converting to MTM predetermined data as a basis for establishing standards in preference to stop watch study which was used in the past.

Today I will relate to you (1) why we are establishing Standard Data in preference to raw MTM studies as a basis for setting work standards, (2) why we choose to utilize MTM in preference to stop watch studies for the establishment of that Standard Data, (3) the method used in developing Assembly Standard Data, (4) the contents of our Standard Data Manual, and (5) some comments on the application of that data.

STANDARD DATA IN PREFERENCE TO RAW MTM STUDIES IN ASSEMBLY

Standard Data Definition:

A synthesis of time for operations or elements of work, analyzed and arranged for ready application to a wide range of equipment, parts or operations.

We have determined it to be necessary that we establish Standard Data and use it in the setting of incentive work standards in preference to the use of raw MTM studies for the following reasons:

1. Speed of application is greatly improved without a significant sacrifice of accuracy. Our checks have shown that the accuracy of work standards established with our Standard Data fall within ± 2% of the work standards established for the same operations where raw MTM studies were employed. Whereas, the time required to set the standards using Standard Data was less than 25% of that required to establish them using raw MTM. Also, the information available in the data provides for a rapid determination of the best method of several possible methods.

2. Consistency of work standards developed is substantially improved because the recognition and categorization of observed elements is simplified. From analyst to analyst, there is considerably less possibility of variation in recognizing "Preposition Large Parts from Wiretainer to Bench Top" than in recognizing "TBCI and W4PO"

to wiretainer, "B" into wiretainer, simultaneous "R6C's" to parts, "G4A," "G4A" limiting out a "G2," "G2," simultaneous "R1C's," "G4A," G4A," "AB," "TBC1 and W4PO" to bench, "M12B" on bench and simultaneous "RL1's."

3. Economy of application is of special significance where low volume or infrequently processed parts or operations are performed. Incentive standards can be established economically for this type situation when using Standard Data whereas it would otherwise be handled on a daywork, unmeasured direct labor basis.

4. Understanding by all concerned is enhanced because actual data is less complicated to comprehend and application is simplified. Mystifying production supervision and direct labor workers is not our aim. We want and need their understanding and cooperation.

5. Simplicity of application makes it possible to train Industrial Engineering personnel more rapidly to understand and apply the data. With normal attrition of Industrial Engineering analysts, this is especially important to the maintenance of a stable, competent work measurement group.

MTM IN PREFERENCE TO STOP WATCH STUDY FOR ESTABLISHING ASSEMBLY STANDARD DATA

Actually, the same reasons for converting to MTM from stop watch studies apply to the use of MTM predetermined times in the establishment of Standard Data in preference to using stop watch studies. Most of you are conversant with these advantages so I'll not dwell on them, but will merely enumerate some of the major advantages as memory refreshers.

1. Attention of observer is automatically focused on the method, and time comparisons before and after an improvement are more readily apparent. It should become second nature to all analysts to always consider the possibilities to eliminate, rearrange, combine or simplify every operation observed.

2. Rating the pace or performance level of the operator being observed is not required, thereby eliminating this variation from your backup data which supports the Standard Data established.

3. Accuracy of supporting standards is increased because MTM forces a detailed analysis of the contents of each operation, thereby eliminating the indiscriminant lumping of elements which is a constant temptation of the time study analyst. Also, more information is available to show the effect of methods variations.

4. A mass of data need not be generated to assure accuracy since MTM predetermined times are already supported by a mass of data. In other words, many rated stop watch studies of an element or operation are required but only one MTM study of a clearly defined operation is needed.

METHOD USED IN ESTABLISHING ASSEMBLY STANDARD DATA

In establishing Standard Data on assembly equipment, parts or operations, the following steps should be taken:

1. A preliminary survey must be taken to determine whether the volume potential is sufficient to justify establishing the Standard Data. For example, we have a rocket launcher, drop-delivery type, material handling structure used to get cylinder crankcases from subassembly to the main assembly line. The model involved is to become obsolete so we have not included "Get Parts from Rocket Launcher to Assembly Table." Instead, we will handle it on a raw MTM basis.

2. Analyze typical operations, i.e., all of the different ways in which parts are obtained throughout the assembly area.

3. Establish elements by deciding where occurrences justify special treatment and what groupings can be made of highly compatible and mutually consistent elements.

4. Develop and separate times of constant and variable elements. From this data, all constant elemental times will be added together and thereafter can be treated as a single figure. The variable elements will be set up in tabular form so that each can be readily selected to fit the specific situation.

5. Develop and isolate time for machine and process elements. (Refer to Exhibit A)

6. Determine allowances applicable to the specific operations. In our assembly operation, this is reduced to a policy matter as parts are light weight and working conditions are consistently good. However, an incentive allowance for machine or process controlled elements

is added to standards in our assembly operations.

7. Prepare final standards for each of the Standard Data elements.

8. Test accuracy of Standard Data standards. This is extremely important and a thorough check of this nature is essential to assure a high confidence level on the part of all personnel who will work with the data.

9. Prepare the Standard Data Manual, the contents of which will be related next.

10. Place standards into effect being certain to provide written operation instructions and workplace layout sketches or photos.

11. Audit standard effectiveness on a periodic basis. This audit should include checks to ascertain that all equipment, tools and materials are correct; the layout of workplace is correct; the operator is following the prescribed method; (the operator has been instructed to follow operation instructions and workplace layout sketches or photos which are placed at workplace whenever a job is new) and that a reasonable performance is being attained by the operator.

12. Use Standard Data to reduce costs through tooling modifications and product design change proposals.

CONTENTS OF ASSEMBLY STANDARD DATA MANUAL

A great deal of variation might be expected as to the exact contents of any Standard Data Manual; however, a significant portion should be devoted to an explanation as to conditions surrounding its effective use. Exhibit B presents the contents of the McCulloch Assembly Standard Data Manual about which brief comments are considered adequate for this presentation.

APPLICATION OF ASSEMBLY STANDARD DATA

When applying the Assembly Standard Data, an analyst will do the following:

1. Observe operation and list part components, tools, fixtures, materials, gages, material handling containers, etc. At the time this is done, analyst makes notes as to methods changes which should be incorporated.

2. Sketch the area available for the performance of the operation, i.e., location of previous and subsequent operations, location of other neighboring operations, bench sizes, etc.

3. Develop rough Standard Data Work Sheet consisting of a listing of the elemental sequence with variables and occurrences clearly set out as subheadings under each main elemental heading. (Refer to Exhibit C) In this approach, the elements are listed as observed on the job as it is being performed. Variables include items such as RPM of driver, number of threads on screw, torque requirements, class of parts involved, distances parts are to be moved, etc.

4. Re-layout workplace. With all the data noted, this can be accomplished in the office in most instances. Then develop workplace layout sheet or photograph which will be put at the work station. (Refer to Exhibit D)

5. Develop final Standard Data Work Sheet for work standard calculation. (Refer to Exhibit E)

6. Develop Job Specification Sheet which informs the production supervisor and direct labor employee as to the exact method which must be followed to make standard on the job. (Refer to Exhibit F)

7. Set up workplace in accordance with the job specification and layout or photograph previously mentioned. The Industrial Engineer will work with the production supervisor or set-up man although once agreed to, the production supervisor has full responsibility to see that it is accomplished.

8. Transmit standard into master standards file.

9. Submit proposals for tooling and/or product design changes through the McCulloch procedure.

10. Audit standard periodically as mentioned earlier.

This, then, is the basic approach followed in the establishment of work standards using the Standard Data approach. Naturally, there is a great deal hidden behind these general comments, so for a little better insight into the manual, let's take a look at the Index of its elements. (Refer to Exhibit G) These are all of the operations which we feel justified in setting up at this time as separate elements because of the high occurrence rates throughout the assembly area.

You will note there are nine basic divisions plus many additional subdivisions. Organization of material provides for expansion of data as dictated by future requirements.

Now let's be even more specific and look at the MTM Standard Element Table for "Components Direct to Assembly Point." (Refer to Exhibit H) You will note that all times shown are per trip rather than per piece. Also at the top of the table, you will see a "Zone Number" label. To appreciate its use, refer to the "Zones Diagram." (Refer to Exhibit I) Rather than to deal with the exact number of inches which the knuckle of the index finger moves, we deal with the distances rounded to the nearest six-inch increment through Zone 4 and the nearest twenty-inch increment in Zone 5 through Zone 7. The accuracy of this synthesis was cautiously checked out before it was finalized. The important thing being the proportion of time spent in reaches and moves relative to the total assembly operation cycle time.

Now referring back to the Element Table, we see that once the zone is ascertained it is necessary to classify the part as to small, medium or large and determine whether jumbled or not jumbled. Also, the type of container from which parts are to be obtained must be known; then, we must determine how many pieces are obtained each trip. When these factors are established, the time required per trip and subsequently per piece is readily determinable.

CONCLUSION

Unfortunately, time does not permit the exploration of more sections of the manual but I hope that this example and the foregoing comments have unveiled an approach to the application of Standard Data to Assembly Operation which will excite the desire for many of you to undertake a similar program of your own.

With the able assistance of Mr. Gene Smith of A. T. Kearney and Company, we feel that we have developed an extremely valuable tool to meet the need for the establishment of Assembly Standards of optimum accuracy with reasonable economy of effort by Industrial Engineering personnel. This was our objective.

EXHIBIT A.

MTM STANDARD ELEMENT FILE 3-7-X-

ELEMENT DESCRIPTION RUN IN SCREWS WITH PNEUMATIC SCREWDRIVER

DATE 4/14/59
ANALYST RB/CDO

MATERIALS, TOOLS, EQUIP. ETC.

DESCRIPTION OF WORKPLACE

APPLICATION OF ELEMENT

Times include a 20% incentive allowance.

TMU's per total threads engaged.

INCLUDES:

MFA To turn on
PT) Formula per attached sheet + 20%
~~RPE~~ To turn off

	Number of Threads	1	2	3	4	5	6	7
		Gun Size - Free Running RPM						
		1050	1200	1300	1400	1600	1800	2000
A	<5	17.5	16.3	15.2	14.6	14.0	13.4	13.3
B	5	21.2	20.0	17.6	16.5	14.5	13.5	13.4
C	6	26.2	24.8	22.0	19.3	15.6	14.0	13.6
D	7	32.5	30.6	27.4	22.8	17.1	14.7	14.0
E	8	40.2	37.5	33.6	26.8	19.3	15.7	14.6
F	9	49.0	45.4	40.4	31.8	21.9	16.9	15.3
G	10	59.2	54.4	48.7	37.3	25.2	18.3	16.3
H	11			57.6	43.6	28.9	20.1	17.4
I	12				50.6	33.7	22.2	18.6
J	13	Do not use this size gun for this many threads			58.4	38.1	24.4	20.0
K	14					43.6	27.0	21.6
L	15					49.5	29.7	23.4
M	16					56.1	32.8	25.3
N	17						36.2	27.3
O	18						39.8	29.6
P	19						43.6	32.0
Q	20						47.7	34.6

EXHIBIT C.

Sheet 1 of 1

STANDARD DATA WORK SHEET

Original Date 6/11/59
Revised Date – No. –
Studied by BULLOCK

Part Name CLUTCH ASSEMBLY
Operation ASSEMBLE
Section No. 651 Machine Code 0601

Part No. 50060
Oper. No. 010
Oper. Iss. # 3

No	Description - Left Hand	#	LH	TMU'S	RH	#	Description - Right Hand	No
	ASSEMBLE 51468 SPRING, 51464A SHOE(4) AND 50144 ROTOR ASS'Y USING DAKE #1 HAND PRESS AND F25456 LOADING FIXTURE.							
							GET ROTOR ASS'Y FROM BOX	
					P1SE		ROTOR ON FIXTURE	
	GET (1) SHOE FROM BOX	2				2	GET (1) SHOE FROM BOX	
	SHOE ON ROTOR ARM	2	P1NSD					
					P1NSD	2	SHOE ON ROTOR ARM	
	GET SPRING FROM TABLE						GET FIXTURE CONE FROM TABLE	
					P1SE		CONE ON ASS'Y.	
							REACH TO SPRING IN L.H.	
	HOOK ENDS		M2C		M2C		HOOK ENDS	
			P1SSD		P1SSD			
	SPRING TO CONE						REACH TO PRESS HANDLE	
	SPRING ONTO CONE		P1SE					
							RAISE & LOWER HANDLE 660°	
	ALIGN SLOTS		M2C					
			P1SSD					
					M8A		LOWER HANDLE	
							PRESS ON SPRING	
	REACH TO ASS'Y						ASIDE CONE FROM FIX.	
	DISENGAGE ASS'Y FROM FIX.							
	ASIDE ASS'Y.							
	MISC. OPERATIONS							
	A. EXCH. BOXES-SHOES 4/100							
	B. EXCH. BOXES-ROTORS 1/50							
	C. EXCH. BOXES-ASS'Y 1/25							
	D. PREPOSITION SPRINGS FROM BOX TO BENCH TOP 1/10							
	E. COUNT & MARK TALLY 1/10							

MCH M2-209 Carried Forward

EXHIBIT B.

STANDARD DATA MANUAL CONTENTS

INTRODUCTION:
- PURPOSE
- CONCLUSIONS
- COMMENTS:
  - GENERAL
  - APPLICATION
  - EQUIPMENT COVERED
  - SPEEDS AND FEEDS
  - MATERIALS
  - COOLANTS AND LUBRICANTS
  - QUALITY REQUIREMENTS
  - SAFETY REQUIREMENTS
  - MATERIALS HANDLING
  - PRODUCTION COUNTS
  - OPERATION CHANGE-OVER OR JOB CHANGE
  - SET-UP
  - ALLOWANCES
  - METHOD OF PAYMENT
  - STANDARDS GUARANTEES

SAMPLES OF WORK SHEETS

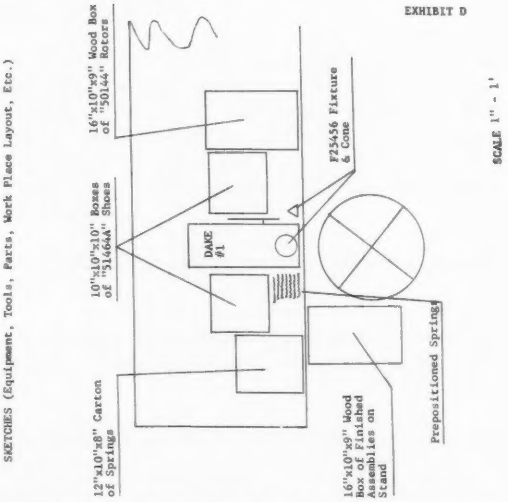
DEFINITION OF TERMS

SPECIFIC APPLICATION INSTRUCTIONS

INDEX

CLEARLY MARKED ELEMENTAL SECTIONS
- TABLES FOR NORMAL REFERENCE
- SUPPORTING MTM ANALYSIS OR SYNTHESIS SHEETS

EXHIBIT D



OPERATION SHEET 3
ISSUE NO.
PART NO. 50060 OPER. NO. 10
PART DESCRIPT. MATERIAL
ROTOR ASSY
4 SHOES
SPRING
Operation
ASSEMBLE
Section 631
Machine DAKE #1 - ARBOR PRESS
Asset No. - Mach. Code 7314
Speed - Feed -
Equipment NONE
Special Tools F25456 - SPRING
LOADING FIXTURE
Gages NONE
Conditions AVERAGE
Quality Requirements. NOT LISTED
Studied by R. BULLOCK
Approved by P.G. CASE

EXHIBIT E

Sheet 1 of 1

STANDARD DATA WORK SHEET

Original Date 6/11/59 — Part Name CLUTCH ASSY. — Part No. 50060
Revised Date - No. - — Operation ASSEMBLE — Oper. No. 10
Studied by R. BULLOCK — Section No. 31 — Machine Code 0601 — Oper. Iss. # 3

No	Description - Left Hand	#	LH	TMU'S	RH	#	Description - Right Hand	No
	ASSEMBLE 51468 SPRING - 51464A SHOE AND 50144 ROTOR ASSY. USING DAKE # 1 ARBOR PRESS AND F-25456 FIXTURE.							
				79	15B4		ROTOR ASSY. FROM BOX	1
				6	P1SE		ROTOR ON FIXTURE	2
3	SHOE FROM BOX		15B3	70	15B3		SHOE FROM BOX	3
4	SHOE ON ARM		P1SSD	16				
				16	P1SSD		SHOE ON ARM	5
6	SHOE FROM BOX		15B3	70	15B3		SHOE FROM BOX	6
7	SHOE ON ARM		P1SSD	16				
				16	P1SSD		SHOE ON ARM	8
9	SPRING FROM TABLE		15B2	61	15B2		CONE FROM TABLE	9
				6	P1SE		CONE ON ASSY.	
				15	24A5		TO SPRING	10
11	HOOK ENDS		M2C	5	M2C		HOOK ENDS	11
			P1SSD	15	P1SSD			
12	SPRING TO CONE		15M2	17	R16B		TO PRESS HANDLE	12
	ON CONE		P1SE	6				
				46	42I1		RAISE & LOWER HANDLE	13
				41	42J1		RAISE & LOWER HDLE. (300°)	14
15	ALIGN SLOTS		M2C	2				
			P1SSD	15				
			R11	10	M6A		LOWER HDLE.	16
				28	43B6		PRESS ON SPRING	17
18	TO ASSY.		R1A	32	71F7		ASIDE CONE	18
19			D1E	4				
20	ASIDE ASSY.		71A3	33				
	MISC							
A	EXCH. BOXES - SHOES 4/100		81E2	31	81E2			
B	EXCH. BOXES ROTORS 1/50		81E12	4	81E12			
C	EXCH. BOXES - ASSY'S. 1/75		81E7	9	81E7			
D	PREPOSITION SPRINGS FROM							
	BOX TO BENCH TOP 1/10		14A15	13	14A15			
E	COUNT & MARK TALLY 1/15		91F5	10	91F5			

Reason for Change:

To remove estimate and set standard for incentive payment.

Total TMU's	692
Normal Hrs. (.00001)	.00692
Allowance 15 %	.00104
Standard Hours	.00796
Pieces per Hour	125.6

EXHIBIT F

STANDARD JOB SPECIFICATION

PART NO. 50060 — DATE 6/15/59
OPER. NO. 010
DESCRIPTION ASSEMBLE — OPERATION SHEET ISSUE NO. 3

NO.	DESCRIPTION - LEFT HAND	DESCRIPTION - RIGHT HAND	NO.
		REACH 24" TO BOX & GET ROTOR ASSY.	1
		PLACE ROTOR IN PRESS FIXTURE	2
3	REACH 18" TO BOX & GET SHOE	REACH 18" TO BOX & GET SHOE	3
4	PLACE SHOE ON ROTOR ARM		
		PLACE SHOE ON ROTOR ARM	5
6	REACH 18" TO BOX & GET SHOE	REACH 18" TO BOX & GET SHOE	6
7	PLACE SHOE ON ROTOR ARM		
		PLACE SHOE ON ROTOR ARM	8
9	REACH 12" TO TABLE & GET SPRING	REACH 12" TO TABLE & GET CONE FIX.	9
		SET CONE ON ASSY.	10
		REACH 12" TO SPRING IN LEFT HAND	11
12	HOOK ENDS OF SPRING TOGETHER	HOOK ENDS OF SPRING TOGETHER	12
13	PLACE SPRING ON CONE IN PRESS		
		REACH TO PRESS HANDLE & LOWER 2 TURNS	14
15	ALIGN SLOTS ON FIXTURE		
		PRESS ON SPRING	16
		RAISE HANDLE 2 TURNS	17
18	REACH TO ASSY. IN PRESS	ASIDE CONE 12" TO TABLE TOP	18
19	REMOVE ASSY. FROM PRESS		
20	ASIDE ASSY. 24" TO BOX ON STAND		
	MISCELLANEOUS		
A	EXCHANGE BOXES OF SHOES 4/100		
B	EXCHANGE BOXES OF ROTORS 1/150		
C	EXCHANGE BOSES OF ASSY'S. 1/75		
D	PREPOSITION SPRINGS FROM BOX TO BENCH TOP 1/10 FROM ZONE 4		
E	COUNT & MARK TALLY 1/15		

Studied by: ______ Standard Hours .00796
Approved by: ______ Pieces per Hour 125.6

McH M2-202 (Front)

EXHIBIT G. — Page 1 of 2

INDEX TO CHARTS

10 GET AND PREPOSITION COMPONENTS
- 11 Preposition Wiretainer and Tub to Basket
- 12 Preposition Wiretainer and Tub to Table Top
- 13 Preposition Pin Rack to Table Top
- 14 Preposition Bin to Table Top or Hand
- 15 Components Direct to Assembly Point

20 FIXTURING
- 21 Position into Fixture
- 22 Clamp and Unclamp Fixture
- 23 Reposition Wilton Power Arm
- 24 Reach to Reposition or Hold Unit

30 HAND TOOLS
- 31 Get and Aside Tools
- 32 Turn Motions
- 33 Torque Wrenches
- 34 Hammering
- 35 Pneumatic Screwdrivers

40 PRESSES AND RIVETERS
- 41 Power Presses/Riveters
- 42 Raise and Lower Arbor Press Handle
- 43 Press (after point of initial engagement)
- 44 Raise and Lower Ram Nose with Hand Wheel

50 MISCELLANEOUS CYCLIC
- 51 Miscellaneous Cyclic
- 52 Palm and Unpalm
- 53 Start Threaded Object
- 54 Washers on Screws
- 55 Bend Lock Strips, Plates and Cotter Pins
- 56 Install Nuts in Pockets
- 57 Brush Sealants
- 58 Clean Parts/Fixtures

EXHIBIT G. — Page 2 of 2 Index to Charts

60 INSPECT/TEST
- 61 Gaging
- 62 Miscellaneous Inspection
- 63 Engine Test
- 64 Miscellaneous Test

70 ASIDE AND POSTPOSITION
- 71 Aside from Assembly Point
- 72 Postposition Assemblies
- 73 Stack from Table Top to Pin Rack

80 STOCK AND EXCHANGES
- 81 Exchange Containers
- 82 Fill Assembly Bins
- 83 Get and Unwrap Bundles

90 MISCELLANEOUS NON-CYCLIC
- 91 Count and Mark Tally
- 92 Miscellaneous Non-cyclic - Low Occurrence Factor (Frequent)
- 93 Miscellaneous Non-cyclic - High Occurrence Factor (Infrequent)

EXHIBIT H. 15-0

MTM STANDARD ELEMENT FILE 3-1-X-

ELEMENT DESCRIPTION GET PART & MOVE DIRECTLY TO POINT OF ASSEMBLY OR OTHER HAND DATE 4/6/59

ANALYST RB/CDO

MATERIALS, TOOLS, EQUIP. ETC.

DESCRIPTION OF WORKPLACE

APPLICATION OF ELEMENT

See attached pages

TMU's per trip

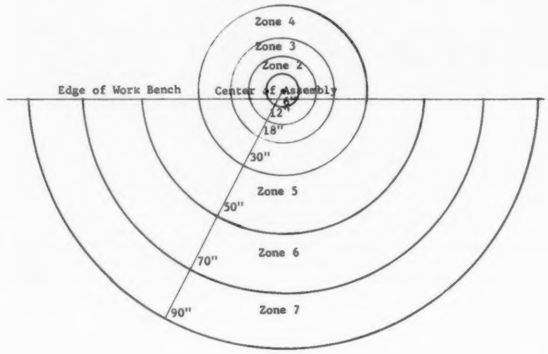
	Pieces Per Trip	Zone Number 1	2	3	4	5	6	7	Pattern Page No.
	From Bin, Pan, Basket or Table Top Small or Medium - Jumbled								
A	1	35.3	44.3	53.7	62.9				1
B	2	51.6	60.6	70.0	79.2				2
C	4	96.0	105.0	114.4	123.6				3
	Reposition small part already in hand.								
D	1	19.3	19.7	19.3	17.3				4
	Large - Jumbled								
E	1	29.7	38.7	48.1	57.3	75.9	109.9	143.9	5 & 6
F	2	40.4	49.4	58.8	68.0	86.6	120.6	154.6	7 & 8
	Small, Medium, Large - Not Jumbled								
G	1	22.9	32.1	41.6	51.0	69.3	103.3	137.3	9 & 10
H	2 *	11.5	16.1	20.8	25.5	34.7	51.7	68.7	9 & 10
	From Wiretainer Large Jumbled (Medium should be prepositioned to basket.)								
I	1					114.2	148.2	182.2	11
J	2					121.5	155.5	189.5	12
	From Pin Rack Large Jumbled								
K	1					83.8	117.8	151.8	13
L	2					91.1	125.1	159.1	14
	Part already in hand.								
M	1	12.3	17.2	22.4	27.5				15

* Factored

EXHIBIT I

ZONES

Zone No.	Inches Maximum Radius
1	6"
2	12"
3	18"
4	30"
5	50"
6	70"
7	90"



Reprinted from Factory, March 1960

COVER STORY

Most managers shy away from incentives in maintenance. They say it's too costly, and highly impracticable. Some say it just can't be done. DeLaval Steam Turbine Company proved otherwise. Incentives there mean payroll savings of $150,000 a year–net.

Here's Proof You Can't Ignore- Maintenance Incentives Do Work

No plant manager or maintenance manager can afford to overlook maintenance incentives. If money talks in most places, here it shouts—direct dollar savings in maintenance labor and indirect savings in production costs.

DeLaval Steam Turbine Company (Trenton, N. J.) knows what we're talking about. In April 1957, DeLaval employed 105 men in maintenance without incentives. Since then, the workload has grown substantially. But now just 82 maintenance men with incentives are doing a better job than the 105 used to do. Maintenance payroll savings run around $150,000 a year, net. Maintenance men averaged some 15% higher in pay during the first year of operation. The incentive program paid for its cost of installation in 8½ months.

When FACTORY editors learned of this achievement, we asked DeLaval to let us make this case study. We suggested a round-table interview for frank discussion. We approached the study with our many skeptical readers in mind. And we posed many questions—the same sort you might have asked had you been there. We probed for intimate details of problems and solutions. We asked for proof of the pudding.

We got all of this—from the group of plant management men most concerned with the project. In the photo on the facing page you see the DeLaval people involved (left to right around table): Richard W. Hart, plant engineer; Charles Jurgensen, vice president of manufacturing; Victor A. Grove, chief industrial engineer; G. J. Stegmerten (brought in as consultant to install the program); Tom F. Connolly, assistant plant engineer; Paul Nurko, works manager. The man in the left foreground (back to camera) is Carl G. Wyder, FACTORY'S senior plant maintenance and engineering editor. He popped the questions and recorded the answers. We have digested several hours of round-table discussion here. DeLaval hopes the details are adequate to spare its busy staff from inquiries, and suggests you send any questions to the consultant, Mr. G. J. Stegmerten, vice president, H. B. Maynard Company, 718 Wallace Ave., Pittsburgh 21.

In this exclusive interview, FACTORY's questions are set in heavy type, while DeLaval's answers are in light face.

THE INTERVIEW

Why did DeLaval adopt a maintenance incentive program? What really got you interested?

Three main reasons:

1. To provide equal incentive opportunities to maintenance employees. This arose from the fact that three years previous we had put wage incentives into our production shops under an agreement with the union. This agreement stated that an incentive opportunity should be made available. Incentives average 20%, run as high as 35%, and are available to all indirect as well as direct workers. Thus we had a contractual obligation that had to be fulfilled in the near future.

2. To reduce maintenance costs. We believed work measurement in maintenance could be made profitable.

3. To create the proper climate for preventive maintenance. In our type of work, where a high degree of precision is required on large machines, a breakdown can create hundreds of hours of maintenance work.

FACTORY's senior editor, Carl G. Wyder (back to camera, left foreground), interviews the men charged with putting the DeLaval incentive plan into operation; They are (left to right): Richard Hart, Charles Jurgensen, Victor Grove, Gus Stegmerten, Tom Connolly, and Paul Nurko.

Aside from the repair cost, the delay in production is usually a serious setback. We felt that maintenance incentives would force the planning needed to achieve our preventive maintenance goals.

How did you decide which type of work measurement you should use?

First we had to face the fact that our industrial engineering department was too busy with shop incentives to take on the development of maintenance incentives. Also, we saw that doing the job ourselves would take too long—we'd do better to bring in a consultant. The gains in savings through quicker installation confirmed our judgment—they more than compensated for the extra costs.

Did you look for a consultant on any specific plan?

No, we wanted to look over all available plans. But first we eliminated the incentive based on historical records as unsuitable. Also we wanted a way to measure maintenance worker performance directly. Bonuses based on production output, machine downtime, and the like, were neither feasible nor acceptable in our job-shop operations. This narrowed the field to plans based on the use of standard data developed by time study—both pre-set and post-set—and time standards imposed by the use of standard work groupings—universal maintenance standards (UMS).

Then how did you decide?

We visited plants practicing each system. We explored the costs of installation and administration and the outlook for coverage. To us, UMS looked more attractive. So we arranged with a consultant, H. B. Maynard Company, to survey the situation in our plant. Within four weeks Maynard submitted a report of conditions, with a proposal for an estimated net saving in labor costs (after deduction of administrative costs and incentive pay) of over $151,000 per year.

Since UMS is a group incentive plan, we had to explain to the union our reasons for favoring it. We showed how the UMS benchmark work groups provide pre-set engineered standards—not guesstimates—for all kinds of work; but only group incentives by crafts, rather than incentives for the individual. The union would have preferred an individual type of incentive comparable to the direct shop incentives. But, as we'll explain later, we couldn't do this with the type of plan proposed.

How did you handle the problem of reducing the maintenance work force?

No problem at all. We were able to place surplus men elsewhere. Transfers, expanded workload, and normal attrition took up most of the slack.

Did the UMS plan require any reorganization?

We made no change in our supervisory organization—plant engineer, assistant plant engineer, project engineer, and five craft foremen. Our clerical staff—a central-office clerk and a maintenance-office clerk—is the same as before. UMS had no effect on the general administrative set-up. It did add three work-measurement applicators as staff. They work in the maintenance office.

Turn the page

R. W. Hart *Charles Jurgensen*

"This piping modernization job is a good example of how maintenance standards can help keep a work project on schedule and within budget."

Do you know what your worker performance was before incentives?

Sure. As part of the preliminary report our consultant made a work sampling study of the time utilization of all crafts. This took two men three weeks. It showed a productive activity of 70.4%; unavoidable delays, 4.2%; avoidable delays, 17.6%; personal time, 7.3%; and absent, 0.5%. Of the productive activity of 70.4%, 40% was in work performance. The balance of 30.4% was in instructions and planning of the job, travel, preparation and securing of material.

Also, each worker was rated. Over-all rating of the maintenance department was 92%. Methods effectiveness was estimated at only 90%, due to unnecessary work, bad planning, poor communications, and the like. Based on these findings, actual worker performance before incentives was 67% (productive activity x performance rating x methods effectiveness x 1.15% allowance, or 70% x 92% x 90% x 1.15%).

Yet we had no real staff planning, no work scheduling. Work was assigned job by job—with no backlog record, because we didn't measure the jobs. Although we had a formal work-order form—two of them, in fact—much work was done without work orders. Thus, costing was inaccurate, with charges often assigned to improper accounts.

We did as well as we did largely because the department operated under a budget and watched it closely. Also, we had a high ratio of skilled mechanics. Our maintenance supervisors, squeezed between budget limits and plenty of work, kept hammering at worker performance. Even so, our worker performance then did not approach what we have under the incentive program.

Many plant men believe work measurement and incentives are the last steps in maintenance improvement —that a good work-order system (planning, scheduling, methods study, and the like) will achieve all the big savings, leaving little for work measurement and incentives to do. Since DeLaval took on incentives before polishing up these other techniques, how would you answer this criticism?

We agree that to make UMS work you need a reliable work-order system, plus planning and scheduling. Our program forced these techniques on us. Thus we eliminated a lot of "two-man" work (craftsman and helper) and cut down needless travel for forgotten tools or supplies.

We hadn't developed all these techniques fully. We were told at the start that our low maintenance efficiency was caused by four things: (1) productive time lost for lack of planning and scheduling, (2) inefficient methods, (3) no man-hour targets for doing the job, and (4) no worker motivation. We were told we needed to improve our work-order system. Also to develop these other functions. But the fact we didn't already have them was no major handicap to quick adoption of work measurement and incentives techniques.

Just what results did you get in worker performance?

In a nutshell, an average boost to 115% worker performance. This figures out roughly as a 72% improvement from our starting point of 67%. It led to a cut in the work force from 105 to 82 men. This despite the fact that the company is now doing more maintenance and new construction than at any time in its history.

V. A. Grove *C. Landefeld*

"Because we can measure our maintenance manpower needs, we can schedule repair and construction jobs better, save up to 35% in labor cost."

Can you translate these results into dollars?

In March 1959, our net savings in manpower ran about $150,000 per year. This saving is based on two facts: first, the starting point of 67% in worker performance just mentioned; second, a cost comparison study of 1400 jobs, which showed the new standard time to be 65% of the old actual time. You can evaluate the manpower requirements this way. Under pre-incentive conditions we would have needed 126 men to do what 82 men can do today—a net saving of 44 men.

Do you consider this 115% performance the top figure attainable?

No. With improved planning, and as the workers' familiarity with the system develops, their performance will improve and result in even higher earnings.

How does management like the incentives program?

With such savings management is enthusiastic. But for other reasons, too. We're getting better utilization of production equipment, better maintenance for the same dollars. And with no increase in overhead. Our original purpose was not to cut the dollar budget, but to get more for our money, and to provide equal incentive opportunity.

We have trimmed the number of emergency jobs. Now, because of

higher worker productivity, we are able to start a preventive type of maintenance we couldn't do before. The continuing demand for closer tolerances on our product calls for better maintenance. We're getting it at lower cost.

How do your workers like it?

At the outset we had the usual number of gripes that you get with any incentive installation. But with time they became fewer. We've had no differences that couldn't be resolved—and without changing the plan's basic principles.

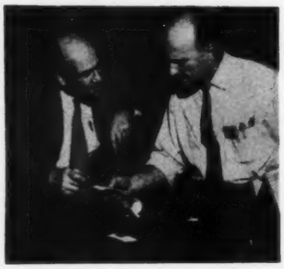
Many plant people feel that work measurement may be good, but that an incentive program isn't worth the extra cost. What has your experience taught you?

We're getting the advantage of incentives for practically nothing. We would have to pay the same administrative costs for work measurement only. We believe worker performance wouldn't exceed 80-90% without incentives. This pattern can be verified by any company operating today on a measured daywork basis. In some crafts performance would be even lower. Our incentives pay the popular "one-for-one" bonus. This means the incentive begins at 100% productivity, and pays a 1% wage increase for each 1% increase in productivity.

How do the bonus payments run among the various crafts?

Although the average today is about 15%, bonus payments range from zero to as high as 33%. To see what this means in craft performance, look at the table below. It's a summary of a two-month study of 1400 jobs taken at random, made before application of UMS while building the UMS data. It compares time charged for work (in minutes) with UMS allowed time.

Group	Minutes charged	UMS allowed	Per cent performance
Yard labor	82234	72807	89
Pipefitters	25268	11454	45
Machine repairmen	35680	18630	52
Millwrights	33972	14190	42
Carpenters	11796	7340	63
Painters	22610	23210	101
Electricians	75350	50129	67



R. W. Hart *A. J. Brilliantine*

"Application of time standards makes us plan repair jobs better, calls for expert craft supervision, and gets machines back into production faster."

When you consider that our performance today averages 115%, you can see what UMS has accomplished—even for the painters. Before, small jobs varied 300-400% in time, in a widely inconsistent pattern. Some jobs that used to cost $10 are now done for $2 to $3.

You have no quality control department to police maintenance workmanship. Any problem here?

No problem. In fact, workmanship has improved. We don't pay for doing a job over. We add time required to remedy poor work to actual job time. Thus when total actual time and allowed time for a week are compared to figure the bonus, the "re-do" time cuts into bonus earnings. That means we have a built-in penalty for unsatisfactory work.

How much did it cost to install the program?

A little short of $103,500. This included the consultant's fee of nearly $75,000 for all services, including preliminary study. The balance of $28,500 was for the salaries of DeLaval applicators for the 15-month period of installation. Based on annual net savings of $150,000, this cost was recovered in 8½ months. It would have taken DeLaval alone at least a year longer to do the job. And we might not have finished up with as good a program.

What about continuing administrative costs?

For our present crew of 82 maintenance men we need only three applicators to analyze the work and apply time standards. (They could even handle a 10% increase.) This ratio of about 30 to 1 is a little better than anticipated. Annual administrative costs run around $18,000. This is somewhat lower than our original estimate, which included a payroll clerk and two industrial engineers, who are not needed.

But doesn't the program introduce a heap of extra paperwork?

No. Calculations by timekeeping and payroll departments are simple. Bonus is paid on a craft group basis and is calculated on weekly performance. These departments aren't concerned about how long it takes to do each individual job. All they want is the weekly totals of elapsed time and allowed time for each craft. The second (allowed) divided by the first (elapsed) gives the worker performance. It's as simple as that.

Here's something else that may surprise you. No mechanic has to clock "on" and "off" on individual jobs. Only weekly total clock time counts. This minimizes clerical work and eliminates errors in reporting or calculating job times.

Then don't you lose out on getting individual job costs? These are helpful to maintenance managers.

Job costs are usually obtained for two reasons: (1) a check on performance, and (2) maintenance cost accounting. But UMS gives us accurate control of performance. As for accounting, all DeLaval orders must bear proper charge numbers for department and type of work. Calculation of these charges would be a normal DeLaval accounting routine with or without UMS. Under UMS we benefit from a standard cost system approach, thereby getting the right charge for every bit of work.

How much coverage do you get?

From 85% to almost 100%, depending on craft. Painters, carpenters, pipefitters, and yard labor approach 100%—in that order. We

T. F. Connolly *Paul Nurko*

"Preventive maintenance routines are set up on an incentive basis. As a result, the plant is better maintained, with fewer production outages."

have to smile at plans that boast only 65-75% coverage. As any industrial engineer knows, you're in danger below 85%—it could mean too much work charged to daywork, leading to false high bonuses. On the other hand, we first tried to get too high a coverage—close to 100% across the board. Thus we were covering jobs we didn't know enough about. Our workers realized this, too—and squawked. We then agreed to place under daywork all jobs of indeterminate character, such as adjusting a gear cutter or engine lathe to close tolerances.

Some plants say they can't develop competent analysts. Yet if they fail to apply proper standards the plan flops—pays too little or too much. Where did you get your applicators (analysts)?

You must get the right type of men. They're the key to success. We feel there are two good sources for maintenance applicators: industrial engineering department and maintenance department. We drew our men from our industrial engineering department. They have responded well to training and are now fully capable of administering work measurement. Craft foremen assist in job planning, but do their own scheduling and set their own priorities. The plant engineer schedules construction jobs, which are also measured.

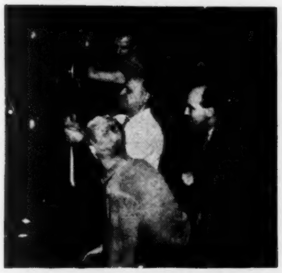
Can you give us a brief rundown of what you did to install UMS? Just hit the high spots—the things that would interest anyone who is thinking about such a program for his plant.

To explain our step-by-step story, let's review the rudiments of UMS. FACTORY described the plan several years ago ("Universal Maintenance Standards", November 1955. *Editor's note: reprints available, 35¢ per copy*). In principle, UMS doesn't try to measure each job to the minute. Instead, it sets up standard work groupings within a series of consecutive ranges of time. At DeLaval we have 20 ranges of time, beginning with the A group of 0-40 minutes, and ending with the U group of 1700-1800 minutes. All jobs in Group A are allowed 30 minutes; those in Group U, 1790 minutes.

It has been statistically proved that for a week's accumulation of work the deviation between work measured by the group standard and that measured by accurately applied standards is small—smaller, in fact, than the hard-to-measure variations caused by differences in working conditions and methods. And only 4% to 10% as much time is required for application.

UMS sets up (through MTM and standard-time formulas) a file of standard work groupings for each craft. It shows the complexion of job content of typical tasks in each group from A to U. These are known as benchmark jobs. Standards are applied to most small maintenance jobs by identifying them with these benchmarks, or by comparing their work content with that of a similar benchmark in standard work groupings, then using that group time value. This technique is called "slotting." Larger jobs are broken down into smaller, and the same comparison method is used.

After installation of UMS only a small percentage of jobs requires a detailed analysis or work study. As new studies are added to the files, the need for such studies tapers off to almost zero. Each standard becomes reference data for future occurrences of the same or similar jobs. At DeLaval 80% of the work



A. J. Brilliantine (center) . R. W. Hart

"We apply standards even to big overhaul jobs like this planer. The necessary planning of each step saves job time, cuts machine downtime."

falls within groups under 8 hours. All longer jobs, which can run into hundreds of hours, are broken down into a series of work orders of eight hours or less. Use of a U value (30 hours) is rare.

Clear enough. Now can we get into your step-by-step installation?

OK. Here we go. There are nine definite steps:

Step 1—Training in Fundamentals. We took three weeks to train applicators in MTM. We also trained two men from the industrial engineering department as extra analysts to fill in when needed.

Step 2—Building Up Data. We developed standard data formulas from which we synthesized the times of the benchmark jobs. We checked time values by work sampling and performance rating. To cut time in application the consultant brought in a library of standard time data—formulas, elemental time data, common groupings. We had to validate it for our use. (To date, this library represents over 50 man-years of work in development.) We now have eight sets of benchmarks, one for each craft, comprising some 50 formulas in each set, plus hundreds of special evaluations. Indexing by categories of equipment or machine tools and by work groupings makes reference easy.

Step 3—Training in Application. Our applicators had to learn to slot

all kinds of jobs into their proper standard work groups. To do this, they must know the work content of a job so they can compare it with a benchmark. Some jobs are easy to identify, such as "install junction box," or "replace brake lining," or "replace sash cord." Other work requests—about 30%—are complex or nebulous and need fuller explanation. For these, the applicator consults the craft foreman for details. If more information is needed, the foreman is given an "Operations Analysis Sheet" on which he lists all job elements after he has made a thorough investigation.

From this analysis our applicator can find equivalent benchmark values. Thus our applicators constantly develop new reference jobs—add new task-time or job-group standards. This is normal in maintenance work, because new jobs are always turning up. But an applicator has to learn not to use these special reference jobs as benchmarks. It would be like using a copy of a standard as a standard—that way he would lose accuracy.

Step 4—Control of Work. With UMS came the rule: a work order or charge for every job—no exceptions. As each work order comes in, an applicator analyzes it for job content. He figures total time allowed (with help of foreman if needed), marks it on order. He marks work that can't be predetermined, such as an open-and-see job, as daywork. No standard is ever allowed, based on time taken to do that job, after a job is finished. If work is likely to be repetitive, an applicator may follow a job to find out what had to be done. The time allowed is based on his findings. There is no large-scale post-setting of standards.

When a job is finished the foreman signs the work order. One copy goes to timekeeping, another to the applicator's file. But often the foreman can't predict all the work content of an order, particularly in electrical and machine repair. Yet, if the ultimate work content were known, the job would be measurable. We solve this problem by having the mechanic write on the order the additional work he did that was not already listed. The foreman checks such an order for additions, then routes it to the applicator for re-evaluation before sending it to timekeeping.

We also use another technique on machine repair with questionable work content. We issue an A order (30-min. standard) to find out what work is needed. After work content is established we issue a detailed work order. We break down large overhaul jobs into sections—dismantling, repair, assembly—and thus minimize daywork.

Sounds good as a procedure on paper. How did your people take to it?

Fine, as we found out in . . .

Step 5—Dry Run. We ran a test for three weeks on all craft groups. Some showed closer to "make-out" than others. The painters were highest. This dry run gave our applicators more confidence.

Step 6—Indoctrination. Now we were ready to go. We held a separate meeting of each craft to explain the program and invite questions. It was scheduled for an hour—and ran overtime. But there were no difficulties. We were able to satisfy all questioners.

Step 7—Application. On Sept. 1, 1958, we started to apply UMS craft by craft, beginning with the easiest (painters). But we didn't wait until all the wrinkles were ironed out before moving on to another craft. To speed things along, we overlapped applications. For example, within three weeks we began with machine repair and pipefitters. To do otherwise would have jeopardized worker morale, cooperation, and unanimity of purpose.

Were foremen a problem?

Somewhat. But education is solving this. It's why we went into . . .

Step 8—Education of Foremen. We found our program was dragging its feet because of a big lack of job planning and scheduling. We had to provide a work backlog so our men wouldn't be idle, waiting for the next job. The painters made a bonus the first week because little planning was needed that wasn't usually done beforehand.

It wasn't all that easy, was it?

By no means. The big roadblock was in determining the work content of each job. At first our industrial-engineer applicators had to lean on foremen for this. (With "maintenance-savvy" men you'd still have this problem at the start, but to a smaller degree.) For a while our foremen had tough going—complained they were busy organizing, analyzing, and scheduling, rather than supervising. So we held foremen's meetings, all as one group, to stress the importance of these activities. Other meetings followed from time to time. Gradually we moved from a hand-to-mouth routine to creation of a backlog. Our foremen now have little trouble handling their responsibilities.

Step 9—Education of Workers. You can expect complaints from workers when you install an incentive program. We had our share. First came the usual objections, such as "Is the standard correct?," "Are the time values reliable?" We always have to take time to prove standards are correct, even if it requires an over-all time study. Then there's the question: "Does the standard cover everything in the job or is it too low in allowed hours?" We showed our workers how to add unlisted work to the work order for re-evaluation.

Now comes the "rusty bolt" complaint—not allowing enough time for unexpected incidents. We answer this one by showing how, in UMS, the work mix averages out the highs and lows in a week's time. At the start, some men—especially the better mechanics—grumbled about group incentive, wanted individual application. There's no answer to this, since an individual doesn't handle enough jobs to get a proper mix. UMS needs a quantity of jobs to smooth out plus and minus variances. We also point out that when different people's activities affect what other people do—as in maintenance, or where working groups change from day to day, this is the place for group bonus.

Another popular question we get is: "How is the incompleted job figured in the weekly bonus calculation?" The answer: We estimate all

incompleted jobs at the end of each week as to the percentage of completion. This percentage is reported as a completed job. Then we write up a new work order for the incompleted portion.

After one year's experience, how do you view the UMS program?

You've seen the results—performance lifted to an average of 115%. But we still have work to do. Performances in some crafts should improve. Now the idea is to boost performance of every man, especially in crafts below 100%. We want more of our people to make more money. This means better supervision, better skills, and better methods. The incentive program has highlighted some phases in our organization that were crying for correction. For example, planning and scheduling were almost non-existent —we were floundering around in the dark. Now we know where to make the next improvements.

What would you do differently if you had to do it all over again?

We should have spent more time in the preparation of our craft foremen. They hardly knew what hit them at the start. But they have recovered wonderfully. Yet we could have avoided this problem with more preparation and training. In general, we might have acted faster in some decisions. But our consultant steered us from any serious mistakes.

Have you any advice for others considering maintenance incentives?

Yes. Here are some major conditions for success in applying maintenance incentives:

- You must believe that incentives can be applied to maintenance.
- You must have higher management backing all the way.
- You must select the plan that best suits your operation. We selected UMS.
- You need a competent staff to install and administer the plan.
- Don't just decide to try out the plan—be ready to follow it through. The problems are numerous. But the benefits to both management and workers are well worth the effort.

END

METHODS–TIME MEASUREMENT ONE OF KELLY'S MANAGEMENT TOOLS

by

Clinton Brauer
San Antonio AMA

"COULDN'T BE DONE," said the critics. "No way to set standards or improve methods, with or without a stop watch, on that kind of work." "That operation is only performed once in a great while." "It's office work." "It's repair work." "IT'S DIFFERENT."

Haven't you heard these statements many times before, or perhaps even said or thought of them yourself.

Nevertheless, Col. G. P. Grubaugh, SAAMA's Director of Maintenance, is doing this in the huge Kelly aircraft maintenance shops and overhead suporting areas, which employes approximately 10,000 personnel of every skill and profession.

Now, according to Col. Grubaugh, if your office or shop operation is being studied while you are in the process of performing your job and you notice that the Engineering technician has a clip board and an observation sheet but no stop watch, don't think he is trying to put something over on you.

The technician is merely applying an advanced Industrial Engineering technique known as Methods-Time Measurement, more commonly referred to as MTM.

Methods-Time Measurement is one of several recognized Industrial Engineering techniques used for developing efficient manual operations and establishing consistent manhour standards, and it does so without the use of a stop watch.

It is based on the philosophy that any manual operation, whether in the shop or office, is performed by employing certain basic elements of motion in different combinations.

These combinations are classified as Reach, Move, Turn, Apply Pressure, Grasp, Position, Disengage and Release. Other basic elements have been classified and defined, such as Eye Travel, Eye Focus, Foot Motions, Leg or Foreleg Motions, Side Step, Bend, Stoop, Kneel on one or both knees, Arise from Kneeling on one or both knees, Sit, Stand from Sitting Position, Turn Body and Walk.

Further classification has been made as to what motions can be combined, such as a Reach and Turn operation with the same body member (Hand).

The Methods-Time Measurement procedure clearly demonstrates what motions can and cannot be performed simultaneously by an average qualified operator. This is one of MTM's outstanding features and is an important key to the successful application of the technique.

Each motion is assigned a predetermined time which is determined by the nature of the operation under which it is performed and the condition under which it is made.

The predetermined times assigned to these motions have been developed as a result of many years of research and investigation by experts in the Industrial Engineering field and they are always the same.

The procedures for arriving at a manhour standard for a job, whether it is turning a screwdriver, punching a typewriter or filling in cards, is simply one of identifying the basic motions required to perform the operation and assigning the predetermined time to each motion.

The sum of the motion times plus the percentage for personal, rest and delay allowances gives the production standard for the job.

However, according to Col. Grubaugh, the Methods-Time Measurement technique is simple when applied by a competent technician, but not as simple to learn and apply as it may have been sounding here. The proper application of Methods-Time-Measurement requires not only a thorough understanding of the procedures, but also a thorough understanding of the motions employed.

Before a technician or an engineer is qualified to practice Methods-Time Measurement, he is required to complete a 105 hour MTM Application Course.

This course is outlined in accordance with rigid standards established by the Methods-Time Measurement Association for Standards and Research at Ann Arbor, Michigan.

This course is identical to the ones offered by some of the nation's leading management consultant firms and universities. Each trainee is required to pass the Association's final classroom examination before he receives official certification to practice Methods-Time Measurement.

Col. Grubaugh revealed that at Kelly AFB, this modern, advanced management training is conducted on a semi-annual basis by SAAMA's Directorate of Maintenance and is instructed by C. H. Brauer, Deputy Chief of the Industrial Engineering Division.

Brauer is the only certified MTM instructor at Kelly AFB and in this section of the Southwest. Since 1955, Brauer has conducted 11 MTM courses, qualifiying approximately 230 Kelly personnel to practice MTM.

Personnel from the various Kelly directorates have received this specialized training, as follows: 156 personnel from Maintenance, 43 personnel from Supply, 11 personnel from Comptroller, 10 personnel from Special Weapons, three personnel from Directorate of Material Support, two personnel from Procurement, two from 2851st Air Base Wing, two from USAF Security Services and one employee from Directorate of Personnel, a Safety Engineer.

The basic foundation for Methods-Time Measurement was, in all probability, laid by Frederick W. Taylor, the father of scientific management, and Frank B. and Lillian M. Gilbreth, pioneers in the field of motion study.

However, the engineering research to develop the Methods-Time Measurement procedure as we know it today is rightfully credited to some of the nation's outstanding management engineers, Messrs, Maynard, Stegemerten and Scwab.

This modern technique is used extensively in private industry not only to establish manhour standards, but more especially to develop effective methods in production, to improve existing methods, to develop time formulas and standard data, to train supervisors in becoming methods conscious and many other Industrial Engineering functions.

Within SAAMA's Directorate of Maintenance, Methods-Time Measurement is used for several important purposes, such as management improvement training, engineer training, methods development operations, developing and establishing standard data and time formulas.

For example, in the Accessories Branch, several work centers are completely covered by MTM standards. In the Manufacture and Repair Branch, five or six sets of standard data have been developed and placed in use. Data developed applies to Engraving, Sheetmetal, General Machine Shop, Tools and Fixtures, etc. In the overhead areas, standard data is being developed for all types of office operations.

Within the Directorate of Material Management, Methods-Time Measurement is being widely used to develop efficient methods and establish standard data for office operations.

The Special Weapons Directorate is initiating plans for using Methods-Time Measurement in the direct and indirect areas.

The Directorate of Supply and Transportation is utilizing the Methods-Time Measurement procedure for developing effective warehousing methods and establishing standard data.

One of the many outstanding advantages of using Methods-Time Measurement techniques is that more attention is focused on the method being used in the performance of an operation.

This, then, gives the engineer and technicians a highly objective tool and avoids any tendency to be or become subjective.

After a technician learns to observe, record and assign time values to motions, he realizes clearly the motions that are absolutely required and the necessity to reduce the necessary motions to a minimum if the best possible method is to be developed.

Methods-Time Measurement training is a valuable tool not only to Industrial Engineering, but to all levels of management personnel who contribute to effective office and shop production methods.

With the emphasis on conservation and "more Air Force per dollar" here at Kelly AFB, which, in its broadest terms, means cost reduction through more effective utilization of

manpower and material resources, Methods-Time-Measurement, with its objective spotlight on methods and product improvment, will continue to grow in application and principle.

And, as Col. Grubaugh put it, "It can be done," and all without the use of a stop watch.

MTM INTERNATIONAL

APPLICATION OF MTM IN THE FARMING EQUIPMENT INDUSTRY

by

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Paris, France

Paris, February 17, 1960

Translation of a talk made at the National MTM Association Conference in Paris on February 20th, 1959 by Mr. A. KONTZLER, Supervisor of Methods and Wages Administration, CIMA, Paris.

Application of MTM in the Farming Equipment Industry

The Compagnie Internationale des Machines Agricoles McCormick-Deering has a general effective of about 10,000 people:

-with General Office in Paris, 9 district offices, a Depot Central Distributor and 4 manufacturing operations.

The general line products of 3 of these operations are plows, tractors, grain drills, fertilizers, mowers, tedders, rakes, potato planters and diggers, pick-up balers, harvester threshers and combines, etc.

The fourth plant manufactures sisal twine, the daily output being roughly 100 tons per day.

In our foundries (core rooms, molding, pouring, milling rooms) as well as in our machine shops, press, heat treating, assembly, painting and packing departments, we intend to introduce MTM progressively and to establish Standard Data on all repetitive operations.

In order to reach our goal and apply MTM as it should be, it is necessary that an important number of foremen and practitioners be fully trained in Methods Engineering and MTM techniques.

We started our training program in each operation during the latter part of 1957. This program is spread over two years so that, for the time being, it is overed at about 60%.

One hundred foremen and two hundred technical men are scheduled to be trained, so that for every seventy workers, our plants will dispose of one trained foreman and two trained technicians. On top of this, supervisors' courses are or will be attended by one hundred staff members and heads of departments.

To apply MTM techniques systematically and with good results, it is obvious that it must be known not only by the foremen, processing men and time study analysts, but firstly by product engineers and secondly by the tool designers. The product engineers must be able to create new products as simple as possible and easy to manufacture and the tool designer must be capable to foresee adequate toolings, quick operating and economic. For this purpose, groups of trainees comprise draughtsmen, processing men, time study analysts, as well as people from Quality Control, Research, Production, etc.

As soon as the first group of 12 men was trained in each of our plants, they were asked to practice, this in order to avoid the unhappiness felt by most people having learned a new technique when they cannot put it into application. Those having obtained the best results and having pedagogic facilities, have been selected as instructors for new training courses. The others have been divided into sub-groups to undertake Methods Engineering in the various productive departments. Each sub-group includes a general foreman and two technicians. They all work under the guidance and supervision of an MTM trained Staff Assistant.

Experience shows that this method is very successful. This because we group under a common effort and for a common action, people who knew each other very little in the past and who were not always of a goodwill one for the other.

At the same time, we destroyed the barriers which had a tendency to grow between some departments. A group job is undoubtedly the one giving the best results. People working in a group become better minded and there exists a kind of trend towards the best methods, as simple, practical and economic as possible.

When talking about "Economic Methods" I am thinking of the Common Market and its effects. In the past, we had only French competitors but with the Common Market, we must be capable to fight efficaciously and advantageously against foreign competitors if we want to be in a good business position.

On the other hand, we should never forget that we have to maintain our employees at work, in other words, we must endeavour to keep themselves as well as their family members in prosperity.

Consequently, it is absolutely necessary, before starting the manufacture of a new product, to foresee the best possible methods, in regard of yearly orders and credits available. By doing so, it is possible to avoid the transfer or the discharging of employees in excess, measures which are always unpopular and which may cause social troubles when better methods are introduced later on.

Although we are only at the starting point with the application of MTM, some very interesting results have been obtained.

Let us have a look at some of them, starting with the mechanized foundry of our tractor works.

The Foundry Superintendent as well as his general foremen and foremen are just through with the MTM training courses taught by his foundry engineer having attended the first training session at St. Dizier.

The foundry works with 450 workers split in two shifts. The daily possible output is 120 metric tons.

As it is the case in most departments, there was a serious bottle-neck in the core room: the assembly of cylinder block cores. This assembly includes four main cores (bottom, cover, front and rear parts) on which 25 smaller cores of various sizes and shapes are to be stuck. The assembly operations were made by a crew of about 20 workers, each of them making the entire core assembly. This procedure required a wide floor space, the workers had to walk often from their work place to the stacking room. It was necessary, to insure the regular feeding of the engine block molding line to start the core assembly group 4 days earlier than the molding line. The subsequent handling and stacking of cores was very important and resulted in many losses of time and floor space. Furthermore, it was necessary to repair or patch, and even to reject some complete cores damaged during their numerous handling operations.

The reorganization of this section by the use of Methods Engineering and MTM technique has been made mainly by the Foundry foremanship.

The benches have been replaced by three conveyors; in front of them, the main cores are checked. Then we can see the preparing as well as the stacking of the secondary and small cores. The conveyors lead towards an infra-red drying oven. When they are dry, the cores are ground to thickness and then inspected prior to their delivery to the molding line. The latter one is just in front of the inspection area. All operations are performed on conveyors. The small cores are stacked in boxes which are placed on inclined racks, just in front of the assemblers. At the present time, and instead of starting the core assembly with an advance of four days to the molding line, we start it only five hours in advance.

The results thus obtained are the following:

Increase of production: 40.5%
0.750 engine blocks p.m.h. instead of 0.534
Cost reduction: 22%
Reduction of floor space: 44%
207 square meters instead of 370 sq.m.

Furthermore, due to a noticeable reduction in handling operations, and delays, the number of cores to be scrapped has been reduced substantially; the actual figures are not known at the present time but they might be of 5 to 6%.

Inasfar as our Redford and Champion core blowers are concerned, they are now well organized and stabilized work places and we are now establishing Standard Datas on them. These Standard Datas are made up with the use of normal time studies and checked with MTM predetermined datas. We are able to make time reductions of about 10% on these machines. It must be pointed out that our time study times and MTM predetermined times are practically the same and very seldom differ more than 1%. This fact, in itself, convinced the most skeptical of our foremen of the precision of MTM.

Considering that our molding units and shake-out installations are synchronized with the minimum time required to have the castings brought down to a given temperature before they are run into the yard, it seemed unnecessary to investigate our molding units for possible improvements, their speed being at optimum.

Nevertheless, with the use of Methods Engineering, it was found that simplified methods could be put into application, such as the elimination of mould weights, the use of simple, light and quick-acting mould clamps. By doing so, the hand cleaning of the conveyor tables could be avoided as it was thus possible to make use of a mechanical scraper. This simple improvement gave an economy in manpower of about 5 to 10%.

It is considered that many other improvements are feasible in our foundry with the systematical application of motion economy, mainly in the molding area and in the milling room.

Wherever it is possible, we intend to reorganize our work places in such a way that the various motions are made within the normal working area, thus reducing the time of manual elements by 20 to 30%, and reducing the fatigue of our workers.

This latter point is recognized by all employees whether they are in the foundry or in any other department, each time their working place has been reorganized with the use of Method Engineering principles and MTM techniques.

It is not my intention to talk about classic assembly or packing work places already reorganized in our three plants and on which the economy of time registered is varying from 25 to 40% since the employees are making synchronized and symetric motions.

Over and above this, in such work places, the quality of our products is always improved.

For the time being and in one CIMA plant, most of our groups in charge of work improvement, are working one entire day a week on a new progressive tractor assembly line which will include 25 to 30 posts and as many side located work places for sub-assemblies. The groups include 3 men each and they always work according to the same principles, having in hand the designs of sub-assemblies as well as those of components parts for which they have to find the best assembly methods. They apply the principles of motion economy, establish routing sheets, make sketches of assembly blocks, fixtures and small equipment required. Briefly, they write up complete data for every working place. The data is then checked and approved by a supervisor prior to their passing to the tool design department for application.

Before the different groups begun their work, they had attended a meeting to receive instructions and information from the local Management in order that their job be properly performed. At a given moment, they were asked to try to eliminate the use of hammers to assemble any part which could be damaged with such a tool. Right away, very skeptical smiles could be seen on many faces. Then they were told that some thirty years ago, a lot of lathe drivers made use of files to finish turned parts, and that they must admit that it is a long time since a file has been seen on lathe benches. Why could we not do away with hammers to make important assemblies?

For the time being, there exist many assembly facilities, such as mechanical, pneumatic and hydraulic presses to assemble tight fitting parts. It is also possible to reduce the diameter of male parts in liquid air or in carbonic gas, although such methods are expensive and hazardous for

the operator. A better method consists in heating female parts such as rings, hubs, pulleys and even ball bearings with the use of electric heating plugs. A ball bearing, for instance, may be brought up to 100°C without any damage and can then be easily drawn on a ground axle, providing the operator has an asbestos glove. This method also makes it possible to check simultaneously the exactness of the ground portion. Now that the above mentioned study is nearly through, we can state that one of our objectives, the doing away of hammers for assembling important and expensive parts has been realized with success.

To mention that each time one of our sub-groups encounters difficulties to solve a problem, he calls upon another sub-group for help and together they always find a solution.

During their studies, our groups make various and numerous suggestions as to the shape, the sizes, the tolerances, this in order to simplify the operator's duties and to make cost reductions. Their suggestions are submitted without delay to the Product Engineering, examined together and as most of them are approved, they are put into application at the earliest possible date.

One of their suggestions, apparently without importance, is the following: "Change from 45° to 30° all end chamfers of shafts, axles and pins." This modification represents a double advantage:

1) The motions of "Position" are easier, so that the class of Position is lowered, resulting in a noticeable economy of time.
2) Any shaft or axle having a chamfer of 30° instead of 45° has an edge whose sharpness is considerably reduced so that when introducing it into another part, it has a much lower tendency to scrape the inner surface (especially when the fit is tight and the fitting of both parts is tremendously improved.)

To introduce Methods Engineering and MTM, it is our opinion that the audio-visual method is the one giving the best results. Working on this principle and in order to help our processing men and tool designers, to select the most economical clamping system for new jigs and fixtures, we make use of a film headed "MTM and Tool Design," made by our American friends. This film shows most clamping systems used in our plants, from the cheapest and simplest one (nuts and flat wrench) to the most expensive (hydraulic or pneumatic clamping device) with a series of intermediary systems. Each scene of this film is followed by an MTM motion study showing the time required both in TMU's and thousandths of a minute. Taking into account the yearly orders and the cost of clamping devices, it is easy to find out, when using the Methods Engineering Chart N° 5 which system is the most economical.

To familiarize our people with Methods Engineering principles and MTM techniques, we also rent films from well-known French organizations such as B.T.E. and A.F.A.P. Their films are generally very interesting.

We are also making some films in our plants showing improved methods with the use of MTM techniques. One of these films is available and has been shown in all CIMA plants. Although we cannot tell whether this film is better than those made outside (frankly speaking it has not the same "finish" as the films made by professional cameramen), nevertheless, due to the fact that it shows departments, work places, people and parts known to most employees of the plant in which the scenes are picked-up, such a film has a good psychological effect on CIMA people.

I hope that my talk may be of some help for the introduction and application of MTM in all French industries.

MTM NEWS

SAN ANTONIO AIR MATERIAL AREA

The attached picture shows Colonel G. P. Grubaugh, Director of Maintenance, presenting the MTM certification cards to SAAMA's eleventh MTM Application Training Class. Receiving the certification card from Colonel Grubaugh is Mary H. Sapp. Other personnel, from left to right, are as follows:

Front row: Capt. H. P. Whidden, Jr., J. N. Chavez, H. L. Slazer, A. F. Whittaker, G. L. Tompkins, K. R. Russell
Second row: A. Person, E. B. Cravens, C. White, J. A. Shelman, E. E. Unsell
Third row: L. H. Ballinger, B. D. Fleming, W. E. Spence
Fourth row: F. B. Trevino, R. L. Flattery
Against the wall: W. P. Spaulding, J. K. Haas, J. D. Adams, M. DeLeon, J. C. Kostelnik, G. R. Farquhar, R. Tarnava, R. Chavarria

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